PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING OF A CHANGE

(PCT Rule 92bis.1 and Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

O'NEILL, Gary
Gowling Lafleur Henderson, LLP
Suite 2600
160 Elgin Street
Ottawa, Ontario K1P 1C3
CANADA

Date of mailing (day/month/year) 15 August 2000 (15.08.00)	
Applicant's or agent's file reference 08-883905WO	**IMPORTANT NOTIFICATION**
International application No. PCT/CA99/00875	**International filing date** (day/month/year) 24 September 1999 (24.09.99)

1. The following indications appeared on record concerning:

☐ the applicant ☐ the inventor ☒ the agent ☐ the common representative

Name and Address	State of Nationality	State of Residence
O'NEILL, Gary Gowling, Strathy & Henderson Suite 2600 160 Elgin Street Ottawa, Ontario K1P 1C3 Canada		

Telephone No.: 613 233 1781
Facsimile No.: 613 563 9869
Teleprinter No.:

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address	State of Nationality	State of Residence
O'NEILL, Gary Gowling Lafleur Henderson, LLP Suite 2600 160 Elgin Street Ottawa, Ontario K1P 1C3 Canada		

Telephone No.: 613 233 1781
Facsimile No.: 613 563 9869
Teleprinter No.:

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office
☐ the International Searching Authority
☒ the International Preliminary Examining Authority
☐ the designated Offices concerned
☒ the elected Offices concerned
☐ other:

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland** Facsimile No.: (41-22) 740.14.35	Authorized officer Eugénia Santos Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
08-883905WO		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/CA 99/ 00875	24/09/1999	25/09/1998

Applicant

WIRELESS SYSTEM TECHNOLOGIES, INC. et al.

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
[redacted]/CA 99/00875

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04M3/56

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 473 363 A (NG DENNIS ET AL) 5 December 1995 (1995-12-05) column 2, line 17 -column 3, line 10	1,11,12
A	US 5 596 635 A (RAO V R GOPALA) 21 January 1997 (1997-01-21)	
A	EP 0 680 190 A (AT & T CORP) 2 November 1995 (1995-11-02)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 January 2000	25/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Vandevenne, M

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/CA 99/00875

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5473363 A	05-12-1995	CA 2169571 A	08-02-1996
		EP 0724806 A	07-08-1996
		WO 9603831 A	08-02-1996
US 5596635 A	21-01-1997	NONE	
EP 0680190 A	02-11-1995	CA 2143591 A	30-10-1995
		JP 7303147 A	14-11-1995

PATENT COOPERATION TREATY

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REC'D 05 JAN 2001
WIPO PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

15

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
08-883905WO		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/CA99/00875	24/09/1999	25/09/1998
International Patent Classification (IPC) or national classification and IPC H04M3/56		
Applicant SOMA Networks, Inc. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 22 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
20/04/2000	02.01.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Martinozzi, A Telephone No. +49 89 2399 8247

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/CA99/00875

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*:
Description, pages:

2,4,5,8,9,18,22-24, 26	as originally filed			
1,3,6,7,7a,10-17, 19-21,25	as received on	12/10/2000	with letter of	10/10/2000

Claims, No.:

1-18	as received on	12/10/2000	with letter of	10/10/2000

Drawings, sheets:

1/4,3/4,4/4	as originally filed			
2/4	as received on	12/10/2000	with letter of	10/10/2000

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   - ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
   - ☐ the language of publication of the international application (under Rule 48.3(b)).
   - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   - ☐ contained in the international application in written form.
   - ☐ filed together with the international application in computer readable form.
   - ☐ furnished subsequently to this Authority in written form.
   - ☐ furnished subsequently to this Authority in computer readable form.
   - ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   - ☐ The statement that the information recorded in computer readable form is identical to the written sequence

listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:
   ☐ the claims, Nos.:
   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-18
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-18
Industrial applicability (IA)	Yes:	Claims	1-18
	No:	Claims	

2. Citations and explanations
   see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

The following document is referred to in this report:

D2: EP-A-0 680 190 (AT & T CORP) 2 November 1995 (1995-11-02).

Re Item V

1) Document **D2**, dealing with a teleconferencing audio bridge, is regarded as closest prior art to the subject-matter of **Claim 1**, and insofar as this claim can be understood (see item VIII), this document shows the following essential features thereof (the references in parentheses applying to this document):

a teleconferencing system (Figure 1; column 2, lines 49, to column 3, line 5) comprising

at least three user terminals, each user terminal having an audio input and an audio output, signals applied to said audio input being provided to a user of said terminal and signals received from said user of said user terminal being transmitted from said audio output (Figure 1, (101-106); column 3, lines 14 to 17);

an active network comprising a bridging arrangement providing separate mixer outputs associated with each user terminal, said active network being operable to transport signals between the bridging arrangement and each user terminal (Figure 1, (107), (108), (110); column 3, lines 6 to 17); and

the bridging arrangement being operable to: receive the signal transmitted from the audio output of each user terminal; and combine said signals and apply the resulting combined signals, through the use of said separate mixer outputs, respectively to each audio input of a user terminal associated with one of said separate mixer outputs (Figure 3, (I_{1-n}), (O_{1-m}); column 4, lines 25 to 44).

The subject-matter of **Claim 1** therefore differs from this known teleconferencing system merely in that "separate mixers associated with each user terminal" are defined therein instead of separate mixer outputs associated with each user terminal and contained in a single entity of the network called "teleconferencing bridge".
This difference relates to an alternative solution to the problem of transmitting the audio signals between the user terminals and combining them to provide each user with an audio input from the other users, obvious to a person of average skills in the art under given circumstances (e.g. depending on the type, the topology and the extension of the telecommunications network the user terminals are connected to) and which provides

the same effect of allowing each participant to the teleconference to listen to a combined audio input signal derived from the audio output signals transmitted by all the other participants via their respective user terminals. Hence said difference does not justify an inventive step.

Claim 1 does not comply with the provisions of **Article 33(3) PCT**.

In fact, as explained below under item VIII of the present opinion, **Claim 1** lacks the combination of features that renders apparent the inventive concept of the description and would contribute to a clear differentiation of the subject-matter of the claim from the prior art at hand.

2) Independent **Claim 13** merely defines the same features as **Claim 1**, applied to a corresponding method, and is consequently not in line either with the requirement of **Article 33(3) PCT**.

3) Dependent apparatus **Claims 2 to 12** and their corresponding method **Claims 14 to 18** do not contain any additional features which, in combination with the feature of any claim to which they refer, meet the requirements of the PCT in respect of an inventive step, because they are either known from or rendered obvious by said document **D2**, document which deals with the aspect of different signal formats (the PCM format being explicitly disclosed in lines 7 to 13 of column 6) - and even of interworking among users of different networks - (see column 3, line 52, to column 3, line 36) as referred to in **Claims 2 and 3 as well as 16**; document which also discloses provisioning of multichannel (e.g. synthesized stereophonic) audio information to the users via the mixer outputs and user terminals (see Figure 8; column 7, lines 2 to 26) as pointed to by **Claims 4, 5, 10 and 17;** and which further suggests the use of a (graphical) user interface to provide a participant to the teleconference with the control over the content and presentation of the audio information he/she receives over his/her user terminal from the mixer output(s) assigned to him/her (see Figures 9 and 10; column 8, lines 3 to 57) as defined in **Claims 6 to 9, 11, 12, 14, 15 and 18**.

Thus, dependent **Claims 2 to 12 and 14 to 18** contravene as well **Article 33(3) PCT**.

Re Item VII

1) To meet the requirements of **Rule 6.3(b) PCT**, the independent claims should have been properly cast in the two-part form, with those features which in combination are part of the prior art (document identified in the description) being placed in the preamble.

2) To meet the requirements of **Rule 5.1 (a)(ii) PCT**, document **D2** cited in the International Search Report should have been identified in the description and the relevant background art disclosed therein should have been briefly discussed.

3) In contrast with **Rule 5.1 (a)(iv)** there is neither an explanation nor any kind of reference to Figure 1 in the description.

4) Reference signs in parentheses should have been inserted in the claims to increase their intelligibility, **Rule 6.2(b) PCT**. This applies to both the preamble and characterising portion.

5) The general statement in the description on page 25, lines 13 and 14 refers to the "spirit of the invention". When used to interpret the claims, it indicates that the subject-matter for which protection is sought could differ from the subject-matter of the claims, thereby rendering the scope of the claims unclear (**Article 6 PCT**). This statement should have therefore not been included (**PCT Preliminary Examination Guidelines, chap.III, 4.3a**).

Re Item VIII

1) It is clear from the description on pages 15 to 21 that the following features, although stated in the description as pertaining to "preferred aspects", are essential - in combination - to the definition of the invention, since no alternatives are disclosed for these central functionalities:

(1) the provision and use of modular connection management software executing on the telecommunications network and based on a proxies/agents architecture;

(2) the provision and use of a mapper;

(3) the provision and use of negotiation management software to resolve the contention arising from the competition between the many users for the shared resources of the network.

Since independent **Claims 1 and 13**, respectively, do not contain these features, they do not meet the requirement following from **Article 6 PCT** taken in combination with **Rule 6.3(b) PCT** that any independent claim must contain all the technical features essential to the definition of the invention.

2) Apart from the remarks hereabove and in addition to those remarks, the embodiments of the invention making use of the features mentioned hereabove (pertaining to the modular connection management, mapping and negotiation functions) as well as of a teleconferencing server, a computer data signal and a computer readable storage medium as described on pages 7 and 8 of the description do not fall within the scope of the claims as a whole. This inconsistency between the claims and the description leads to doubt concerning the matter for which protection is sought, thereby rendering the claims unclear as a whole (**Article 6 PCT**).

3) The term "an *active* network" used in **Claim 1** is vague and unclear and leaves the reader in doubt as to the meaning of the technical feature to which it refers, thereby rendering the definition of the subject-matter of said claim unclear (**Article 6 PCT**).

4) Dependent **Claim 14** contravenes the clarity requirement of **Article 6 PCT** because the term "*the* proxy" employed therein has no antecedent in the claim itself nor in independent **Claim 13** it depends from.

5) Dependent **Claim 15** also contravenes the clarity requirement of **Article 6 PCT**. It is indeed not clear how an "interface [can] *comprise choices* made by the user". It would have appeared more appropriate to use a term such as 'indicates' instead of "comprises", which would have had the additional advantage of suiting better the category of said claim (a method claim).

Method and System of Teleconferencing

Field of Invention

The present invention relates generally to telecommunications, and more specifically, to a system and method of teleconferencing.

Background of the Invention

Teleconferencing systems allow people at different locations to converse as if they were in the same room. In spite of the currently high cost and complexity of these systems, they are commonly used for business applications, because of the resulting reductions in travel time and cost. However, the cost and complexity can not generally be rationalized in other applications such as academia and private use, so teleconferencing is not common in these areas.

Traditional teleconferencing systems consisted of single microphone and monophonic speaker arrangements at each physical location participating in the teleconference, and the methodology was to broadcast the loudest voice to all other participants, blocking the remainder of the voices. However, the art has been evolving and systems are now available which offer such added features as video signals of the participants and stereo sound. Generally though, these new features present even greater demands on the carrier networks in terms of higher bandwidth and lower latency, which results in even higher cost and complexity. This largely explains the limited availability and use of such advanced teleconferencing systems.

Generally, each teleconferencing system is designed to be used with a specific communication network. Presently, two communication networks are dominant: the public switched telephone network for voice, and the Internet for data. These systems are typically composed of terminal equipment such as telephones or personal computers, an access network such as a telephony local loop or a radio link, and a backbone network such as the public switched telephone network (PSTN) or the intercity data networks. Although the needs of users at the terminals vary greatly, the backbone networks must handle highly standardized loads in order to operate reliably and efficiently. Therefore, traditional communication networks focussed on the provision of single services rather than differentiation. There is no incentive for telephone companies to offer varied features or to serve small niche

telephone network (PSTN) which deliveries each voice signal to a conference bridge This conference bridge mixes the voice signals and returns them to audio amplifiers and speakers at each location.

The conference bridge is implemented as a new hardware component connected to the switch providing the service. Adding a new feature such as Dolby noise reduction or bass boosting requires a physical change to the hardware and/or software in every switch that offers the service.

Changes to existing telecommunication networks are therefore very complicated to make. There is a rigid model and hardware structure is difficult to extend, so existing telephone companies are forced to focus on broad services. When they do develop new products they inevitably take a long time to bring to market and are expensive to implement.

Telecommunications systems need to process the data flowing through in complex ways, often with processing occurring on computer systems separated both geographically and administratively. Many communications paths are simultaneously active, and the processing applied to the various flows of data changes frequently and in a wide variety of ways. The software needed to control these computer systems is generally large, complex and difficult to change.

The complexity of present telecommunications systems software, and the extensive interactions between its software components, makes the development of new features very difficult. As well, telecommunication services have traditionally been provided by large monopolies who employed proprietary equipment that only they had access to. Large telephone companies hesitate to allow open access to the control of their switches and servers due to the risk of failures and the resulting damages that would occur; therefore, only very limited access is allowed.

Software development for telephone companiesis therefore limited to a "closed" group of trusted developers, which reduces the talent pool available and shuts out developers with new ideas for niche markets.

In summary, problems with the PSTN include:

1. system complexity results in long time to bring new products to market;
2. cost of services results in focus on few specific services rather than diversity and niche markets;

it is consistently available, as there is no way to specify quality of service (QoS) in Internet applications.

As noted above, typically, each existing teleconferencing system is designed to operate over a particular network and is not capable of cooperating with the many varied networks now available. These networks include public switched telephone network (PSTN), Internet, cellular telephone systems, satellite communications, local area networks (LANs) and wide area networks (WANs). Within these networks there are a variety of media including optical fibre, wireless or hardwired electrical connections, which execute communications over these networks in analogue or digital format using a variety of different protocols. Many of these networks have been widely implemented, at considerable capital cost, so it is unlikely that they will be quickly abandoned and a new, standard, world-wide telecommunications network constructed. Therefore, there is a need for a system which is capable of implementing teleconferencing over a mixed combination of communications networks.

Asynchronous Transfer Mode (ATM) networks, for example, use standard protocols for addressing packets of data and setting up connections, and have typically been deployed in the core of backbone networks because of the high speeds at which ATM equipment operates. Because ATM routers are not directly accessible and because of the complexity of their mechanisms for describing QoS, these mechanisms have not been used by applications software.

Besides the IP and ATM networks mentioned above, there are other data networks such as Frame Relay and Ethernet. As well, the PSTN may also be used to carry data, for example using trellis coding which maps digital data onto an analogue signal commonly; which is commonly used by Personal Computer modems. Variants are also evolving of each major type of network, and engineering differences between implementations of these networks result in different performance. The complexity induced by this variety makes it difficult for users and application software to exploit all the networks available, and to exploit any to its fullest extent.

Feature development is already difficult for the simple application of teleconferencing over voice networks. As new media such as videophone, typed messaging, shared files and whiteboards are mixed with traditional teleconferencing products, and new applications such as distance learning, Internet Relay Chat and Internet gaming, develop, the problem is becoming even more severe. This problem

will grow even greater as expectations develop for features from one domain to be mapped into another, as when customers expect a feature similar to call-waiting to apply in videoconferencing or Internet gaming.

Furthermore, even for a single application, different users may have different needs, for example, requiring different degrees or forms of encryption. Therefore, there is a need for a system which can allow many cases and features without becoming complex, slow to develop and slow in operation.

There is therefore a need for a method and system of teleconferencing that may be implemented over mixed telecommunications networks, and addresses the complexity of such existing networks to provide an open, scalable and flexible architecture.

Summary of the Invention

It is therefore an object of the invention to provide a method and system of teleconferencing which addresses the problems described above, at least in part.

One aspect of the invention is broadly defined as a system for teleconferencing comprising: three or more user terminals, each having an audio input and an audio output; a telecommunications network interconnecting the user terminals and operable to transport data to and from the user terminals; separate modular mixing software for each respective user terminal, executing on the telecommunications network, and operable: to receive separate audio signals from the audio outputs of the others of the user terminals; and to combine the separate audio signals into a signal for the audio input of the respective user terminal which correlates to the needs of the respective user terminal.

Another aspect of the invention is defined as: a server for teleconferencing comprising: means for interconnecting user terminals and transporting data to and from the user terminals; means for executing separate modular mixing software for each respective user terminal, the separate modular mixing software including: means for receiving separate audio signals from the audio outputs of the others of the user terminals; and means for combining the separate audio signals into a signal for the audio input of the respective user terminal which correlates to the needs of the respective user terminal.

An additional aspect of the invention is defined as: a method of teleconferencing comprising the steps of: receiving, at a separate modular mixer

requirements were to be handled in a single piece of software. As this piece of software code would be unmanageably large, complex and slow, existing systems have simply not offered such diverse services.

Similarly, the use of mixers **20, 22, 24** executing on the telecommunications network **18** offers a substantial improvement over existing Internet based teleconferencing as well. Typically, Internet methods broadcast all voice streams to all participants, so each terminal receives up to (N - 1) streams where there are N participants. This places a tremendous demand on the bandwidth of the final connection to each user and a tremendous load on the network. In contrast, the invention requires only the number of audio channels that the user requires at his audio output, to be sent to the user. That is, if the user desires monophonic output, only one channel is required, and if stereo is desired, two channels. Quadraphonic sound, surround sound, central bass and other audio arrangements would require corresponding numbers of audio channels. This greatly reduces the bandwidth required to each user and the loading on the network.

Thirdly, it is also significant that the mixers of the invention are implemented in a modular manner. As will be described in greater detail hereinafter, all of the software components of the invention are implemented in small modules. Having small modules designed to handle very specific tasks results in a far simpler system than those like the existing PSTN. The more defined the task that a module addresses, the easier it is to design that module and later, to integrate it into the rest of the software system. This is fundamental to the provision of a system that is flexible and open.

Other advantages of the invention will become more apparent from the description of the preferred embodiment which will be presented in terms of an example.

Figure 2 presents an exemplary physical layout of a teleconference in the preferred embodiment of the invention, having four participants. Two participants have direct access to an active network, while two are connected to the PSTN. The term "active network" refers to a network that is operable to execute the mixer software and other related software components described hereinafter.

Participant A has a personal computer (PC) **26** connected to a first active network **28** via a wireless connection **30**. The entity on the active network **28** which serves Participant A is called a NetPort **32**. The specific role of the NetPort **32** within

the active network **28** will be described in greater detail hereinafter. The PC **26** is running a stereo-enabled Web browser with a RealAudio plugin that implements streaming audio and is output at speaker **34**. The PC **26** also has a simple microphone plugin that passes samples from the on-board microphone **36** back to an IP address. Participant A also has a WebCam **38** connected to her PC **26**.

Participant B is connected directly to a second active network **40**, but in a location geographically remote from the first active network **28**. Participant B also listens from a speaker **42** connected to his PC **44** through a streaming-audio application, but is talking through a wireless telephone **46** for its boom microphone. Participant B is plugged into a second NetPort **48** through a telephone jack and hardwired connection **50**.

Participant C is connected to the POTS **52** (plain old telephone system) via a plain black rotary-dial telephone **54**.

Participant D has two speaker phones **54, 56** fed by two separate POTS lines. He also has an Internet connection via a PC **60** which runs a Web browser, but his Internet Service Provider (ISP) does not provide good enough quality of service (QoS) for voice, so he just uses it for the graphic user interface (GUI).

A GUI is piece of software that presents data to users in a graphical manner, allowing for easy interpretation and modification. It is preferred that the invention be implemented in such a manner, where possible. The GUI runs as Java in the PC browser, and communicates with call processing applications running on the active network by means of sockets. Invoking it involves typing a URL (uniform resource locator such as "coolPhones.com"), after which it sits in a window waiting for an incoming call or a user input event to place a call. Inputs can be made via a mouse, keyboard, trackball, touchscreen, joystick or other similar manner. The GUI is strictly an interface, though, since it is unacceptable, for example, to have voice-mail fail when the PC is not active. Therefore, the real call processing decisions are made on the active network side.

This exemplary system also includes an Internet network **62**, which is connected to the PSTN using, for example, H.323 and SIP (Session Initiation Protocol) connections. These connections are known in the art, as are others. The Internet network **62** is also shown to be connected to both active networks **28, 40**, but many other system topographies are also possible. The invention is not limited by any particular topography.

While the teleconference is in progress, Participant A hears Participant B on the left, Participant C in the middle and Participant D on the right, because Participant A is mixing the other participant's monophonic voice streams into a metaphorical stereo spectrum. The use of the stereo output has two major advantages. Firstly, it aids in identifying which participant is currently speaking. Secondly, it allows higher noise levels to be tolerable to participants due to the "cocktail party" effect. This effect acknowledges that people are able to converse comfortably with one another in an environment where there is considerable background noise, provided that they have a means for identifying and focussing their attention on a particular speaker. The use of stereo sound has been shown to provide this identification.

Stereo sound can be synthesized in a number of manners. In a simple implementation, amplifier gain can be varied between the left and right channels, for example: one participant may be played at full volume on the left channel and none at all on the right, a second may be played with full volume on the right channel and none on the left, while a participant may be played at equal volume in both channels. More complex implementation of stereo may, for example, introduce a delay to the audio signal before playing it on one of the channels, simulating the additional time the sound takes to travel to the farther of the listener's two ears in a regular physical environment. Such methods are generally known to those skilled in the art.

Accordingly, Participant A's GUI screen shows a Web page with Participant B's picture on the left, Participant C's number in the middle and Participant D's caller-ID name on the right. In each case, the GUI displays the best identification information that it has available for each participant. This identification may include a URL or telephone number. As well, "screen-pop" information could be provided which identifies personal information about the participant such as his address.

As well, via the GUI, Participant A can click on "ear" and "eye" icons for each of the three participants on her screen to enable or disable their ability to hear her or to see her through the WebCam. Participant A can also drag on a "mouth" icon to set the volume level at which they speak to her, and drag participants left and right to adjust their stereo imaging. Alternatively, the volume level of participants could be governed by their physical location on the GUI display - the further a participant's icon is away from an icon representing the user, the lower their volume level. Another preferred feature of the GUI is that when someone speaks, their icon becomes brighter then gradually fades again with inactivity.

Similarly, Participant B hears Participants A, D and C in a metaphorical stereo spectrum from left to right. Because he finds the sound of participant A's voice close to that of Participant C, he has chosen to separate them spatially as much as possible. This is done with the same type of GUI described with respect to Participant A above.

Participant C hears a conventional four-way conference call, with the voices of the three other Participants companded and mixed together. As a result, she has difficulty distinguishing Participants B and D. However, she has the flexibility to tailor the call to some extent with the preference for single voice dominating, adding noise filters, or other functionality via her proxy. This addition of functionality directly to PSTN customers is very significant. As explained in the background, PSTN services are driven by a supply model that only provides commodity services, and takes a long time to provide those limited services. There is a vast PSTN infrastructure which provides single monophonic lines into millions of homes and businesses, all of which are shackled with these limitations. The use of proxies in the manner of the invention provides greater flexibility and access to new services which may be implemented quickly and at very low cost. More details are provided hereinafter regarding the preferred use of proxies.

Participants who do not have the capability of interacting with the active network will have generic proxies assigned to them which are dictated by the nature of their telecommunication connections. For example, the system knows that a Participant only has PSTN access if that is the connection the call manager has identified as the best connection during call setup.

Participant D has a similar stereo arrangement, over which he has defined Participant A to reside on the left speaker telephone, Participant D on the right speaker telephone and Participant C on both channels. This arrangement also creates a metaphorical stereo spectrum. Other means are known in the art for carrying stereo over the PSTN, but such methods generally require more complicated hardware at the Participant's end. Participant D has the same GUI as Participants A and B so he is able to control his proxy and mixer on the active network directly.

As an example, exemplary signal processing software for participant A is presented as a block diagram in **Figure 3**. Voice streams from other participants arrive in different forms and need to be converted to a consistent form, companded and then mixed. They also need to be transmitted across the radio link in an efficient

form, and other signal processing such as echo cancellation/suppression may need to be done on the voice data. In this case, RealAudio has been chosen as the consistent form though MP3 or a number of other forms could be used. RealAudio is particularly convenient as it is a realtime streaming standard that is well known in the industry and for which many tools are currently available, such as codecs and mixers. This type of processing is also required for the other listeners, and it takes slightly different forms for each participant which correlate to their respective setups.

Not shown in **Figure 3** are such functions as encryption, tone controls and level control, though their implementation follows logically from the description provided herein.

Specifically, pulse code modulated (PCM) voice streams are received from Participants C and D, which are connected to RealAudio converters **64** and **66**. PCM is the standard transmission form for audio in the PSTN. Since the voice signal received from Participant B is already in RealAudio format, which comprises data packets and is easily transported over IP, it is not necessary to convert it before passing its signal to the RealAudio mixer **68**.

The RealAudio mixer **68** combines the incoming audio signals in accordance with the participant's requirements. In **Figure 3**, a bi-directional Activity and Control line is shown which interfaces the RealAudio mixer **68** with the PC **26** via an Ethernet card **72**. The audio output of the RealAudio mixer **68** goes to the Ethernet card **72** as well, and also to a PCM convertor **74**.

This PCM convertor **74** feeds the echo cancellor **76** with an audio signal that more or less matches the output from the participant's speaker **34**. This way, the echo cancellor **76** can remove the speaker output signal that is inadvertently picked up by the microphone **36**. The PCM signal leaving the echo cancellor **76** is converted to RealAudio at the voice coder **78**.

RealAudio packets are numbered sequentially to ensure that they are arranged in the proper order when they are decoded. Generally, it is not necessary to time stamp packets as the time delays are short, and the varied delays in data packets that result from their transport from different sources, or by different routes, will not generally be detectable by the participants. In fact, RealAudio may deliberately add a delay to the incoming signals by storing them in a buffer to absorb signal jitter. As the data is arriving in finite and distinct data packets, there will inevitably be some degree of jitter, so buffering is preferred. A buffer that causes 20

mSec - 50 mSec delay is sufficient time to absorb the effects of jitter most of the time, and is not long enough to annoy the users to a great extent.

Also, note that all audio signals passing between the NetPort and NetPort Manager are in RealAudio form, and not PCM. This makes the transport over the digital interconnection more convenient.

Other preferred aspects of the teleconference are outlined as follows:

1. **Call Setup**

The most important aspect of call setup is the identification of the participants, where they can be found and then of course, creating the connections. In the preferred embodiment, the teleconference will be created by one or more of the participants who are GUI-enabled. These participants will advise the network of the identities of the participants and the call setup software on the network will make the connection with the participants.

Some of the participants will have Internet addresses, while others will have telephone numbers. In each case, the call setup software will investigate the participant and establish the best possible connection that it is aware of. Those participants without Internet access will be assigned proxies which reflect the resources they have access to. For example, if the call setup software identifies a PSTN telephone number as the best connection, it will assign a PSTN proxy to that participant unless advised otherwise.

In the preferred embodiment, all participants who are GUI-enabled can add participants to the call, but for high-security teleconferences, addition of participants should be controlled by a single participant.

2. **Telecommunications Operating System**

The telecommunications operating system aspect of the invention provides unified control and access to all system resources and networking links, with the functionality in and implied by **Figure 3**. This represents a large collection of signal processing and control functions connected together in response to the commands of the callers.

This contrasts with the "pure Internet Protocol" approach which require cooperating tasks in all of the various computers to arrange to do their parts of the processing through an application-specific protocol built on socket() calls, with no single program having an overview of the whole setup. This makes it very difficult to optimize and manage the system, and each such

application has to reinvent call processing. The invention uses socket() as part of the underlying implementation in a preferred embodiment, so that the invention is built as a middleware layer on top of IP.

In "telephony classic" one would not attempt to set up something with this generality in software, but would make special "stereo conferencing server" hardware that assumes all inputs and outputs are PCM and would add special numbers to call in order to connect to it. The need for specialized hardware makes this a "closed system", in which innovation is slowed down by limitations on who can develop new telecommunications applications

3. Proxy

It is preferred that the invention be applied to a network which employs a graph model as described in the co-pending patent application under the Patent Cooperation Treaty, Serial No._____, titled "Connection Manager for Telecommunications". While a single application program is used to see and manage the entire connection, including IP and videoCam connections as well as voice streams, that application is constructed by collecting together "agents" from "proxies".

A proxy is a piece of software that acts on behalf of a specific party to a connection. In this case Participants A through D, and each of the networks and Internet providers are separate parties with separate proxies. A proxy contains data that represents the preferences and state of the party, such as whether Participant A is already on the telephone and whether the first active network's **28** voice trunk is getting full, and has components that are agents to do specific tasks, such as responding to off-hook on a telephone and managing a voice call in progress.

The terms proxy and agent are sometimes used interchangeably in the art. For the purposes of this document, they are distinct: a proxy is built out of agents, each of which handles a special situation. Therefore, the proxy does not comprise an immense block of code with all conceivable functionality, but in its simplest form, is merely a supervisor which instantiates software agents as required, discarding them when their tasks have been completed.

These agents are sent to parts of the system in which signal processing is going on and are connected to the signal processing code or hardware through a "controlling application". This architecture of proxies, agents and

controlling applications is what allows connection management applications to appreciate the whole structure of a connection while still being "owned" by several different parties.

Proxies should persist in the presence of component failures, so that, for example, a user's forwarding instructions do not get lost during a crash. It is preferred that persistence be provided via a distributed database which is continuously updated, so that all concerned parties are aware of the status of the communication. In the event of a failure, the system is able to work around the failure, allowing the communication to continue. Such transactional interaction techniques are known in the art.

In the "pure Internet Protocol" approach there is only custom software running on hardware belonging to the various parties involved and communicating through socket() mechanisms in an ad hoc protocol. The invention builds an additional structure on top of this.

In "telephony classic" there is a single very large program that looks at a database for all users and decides what they would want to do. This program is too large to modify quickly, and can only be modified by the equipment manufacturer. Again, this approach is not flexible enough for rapid evolution of new features. The architecture of the invention makes it easier to understand and modify software, without the same complexity, allowing the system to be open to software development, so that new features may be brought to market very quickly.

4. Graph

It is preferred that the invention be applied to a network which employs a graph model as described in the co-pending patent application under the Patent Cooperation Treaty, Serial No._____, titled "Method and System for Configuring Communications Systems". Briefly, the graph model constructs the signal processing and communications structure as a mathematical graph, which is later implemented by taking "filters" that implement the nodes out of libraries and modifying them, either by a dynamic linking process or by setting the IP addresses to which they make socket connections, to have the interconnection structure specified by the edges. This graph is also used for communication among the agents, as the data structure that defines a

of software makes it easier to maintain real time operation as there are more options available to schedule timely execution. As well, distributed operation improves scalability and speed. The use of agents and proxies lends itself to the efficient use of a distributed system, in that agents and proxies may be assigned to run on different nodes of the system. Ideally, agents will be located close to where they are required, to minimize time delays in communicating with the entities they represent. Such a suitable distributed RTOS is described in the co-pending patent application under the Patent Cooperation Treaty, Serial No._____, titled "Distributed Telco".

Figure 4 presents a block diagram of an exemplary operating system architecture in a preferred embodiment of the invention. A distributed communications substrate **80** is interposed between user processes and the underlying machines, so that processes can generally be moved from one machine to another without being aware of it, either to distribute load or to recover from failures.

Processes running in the system come from different sources and accordingly get different treatment in terms of the trade-off between security and performance. Call-processing functions acting on behalf of the end users run in a protected "sandbox" environment on a virtual machine. Those working on behalf of the network provider may run there, but may also be implemented directly as processes running on the network operating system. User processes running as "filters", with the hard real-time demands that come from being in the signal path, and also run directly on the communications substrate **80**. Processes belonging to different users are protected from each other by the usual operating system mechanisms such as memory mapping and file privileges, but the source is also reviewed by the network administrator. Filter processes on the same machine and part of the same call may share an address space and a thread of control, with data being passed with a function call mechanism and with connections to other hardware being handled by a stub that adapts a function call to a socket-type mechanism. These filters would still be dynamically linked, even with the function-call mechanism.

Signals pass through filter processes **F**, which also implement drivers and performance-sensitive functions on behalf of the network. Call processing on

behalf of users is handled by **CP** processes running in a secure virtual machine **VM** environment, which also includes checkpointing functions that can transfer control on failure to a "ghost machine" **82**. All these processes run on the common software communications layer **80**, which places them on appropriate physical systems and arranges for their connections. Server processes **S** also run on the communications substrate **80**, but do not have the hard real-time constraints of the filter processes. Secure call-processing functions are one type of server process.

5. **Mapper**

The allocation of tasks and network capacity to different communications graphs is done by an optimizer called the **mapper**. There are in general many ways that a graph representing a desired communication can be allocated to a physical network: each of the filters can run on several different nodes, for example, and sometimes there are several types of links over which data can be carried. The simplest embodiment uses hints from the proxies about where to put radio links, that is, after the voice coder, and then applies a "greedy algorithm" to put computing resources as close to the network edge as possible. A good mapper should be a distributed application in which local decisions are made with local knowledge to the greatest extent possible. It is not essential to get a global optimum, as long as resources are not seriously wasted.

In the case of the invention, the most significant resource management problem is the handling of the voice streams. In having a separate mixer for each of N participants, each mixer will receive (N-1) voice streams. The mapper must balance the benefit of distributing the mixers among various processors against the extra cost of transporting redundant audio signals. The factor that governs these decision in the implementation of the invention is quality of service (QoS). Methods of distributing such real time loads are known in the art, but in the case of the invention, the solution will vary with each set of participants and network topography.

6. **Negotiation**

It is preferred that the architecture for agents provide for use of the negotiation system described in the co-pending patent application under the Patent

Cooperation Treaty, Serial No._____, titled "Method and System for Negotiating Telecommunication Resources.

Many users are competing at once for the shared resources of the network (including its computing capacity). It is preferred to apply a market model to resolve this contention: agents for the parties involved offer and demand payment as part of connection setup, and a connection does not happen until all parties have accepted it. A caller can choose to try a connection at a reduced quality level if the cost of the high quality connection becomes too high. For example, on Christmas Day, the load may be temporarily high, so users can expect to get through with reduced voice quality rather than getting a busy signal.

In "pure Internet Protocol", temporary congestion is resolved on a "best efforts" basis and packets may be almost arbitrarily thrown out, and at a longer time-scale by overprovisioning the network so that failures are not too frequent. With differential service a small number of priority classes are defined, but the definition needs to be managed. The market model of the invention can be used to manage differential service, allocating high priority access in such a way as to permit guarantees on service.

In "telephony classic" contention is managed by call admission (first-come, first served) and again the network is overprovisioned so that failures are not too frequent.

Negotiation management may be implemented by having a negotiation agent for each of the user terminals and for each of the multiple telecommunications networks. Each negotiation agents is operable to execute somewhere on the telecommunications system, for example, on the active network, and represents the interests of its respective party in negotiating communication over the telecommunications network. This is done by identify participants in the negotiation and then passing a graph data packet which describe the proposed connection, to each participant for their consideration. Each negotiation agent may either accept, reject or revise it to make a new proposal to the other negotiation agents.

When all or part of the graph data packet is to be executed, a device simply assembles the listed filters in the manner defined in the graph data packet.

Other applications such as animated video, stereo input at the participant's locations, voice activation, automatic gain control (AGC) at the user's PC, and signal shaping to compensate for the frequency response of certain devices or software in the system, are all known in the art, and easily applied to the invention.

Examples have been shown to demonstrate various aspects of the invention, but the number of variations is by no means complete. Comparable implementations could be made for any telephony device, including personal digital assistants, fax machines, pagers, point of sale computers, amateur radios, local area networks or private branch exchanges. While particular embodiments of the present invention have been shown and described, it is clear that changes and modifications may be made to such embodiments without departing from the true scope and spirit of the invention.

The invention could also be implemented to a lesser extent on existing Internet and PSTN networks. For example, Internet servers could be given much of the functionality of the invention similar to applications such as NetMeeting. On the PSTN a specialized server could be attached to a class 5 switch. These implementations would not have all the benefits of the invention, but could apply certain aspects of its teachings.

The method steps of the invention may be embodied in sets of executable machine code stored in a variety of formats such as object code or source code. Such code is described generically herein as programming code, or a computer program for simplification. Clearly, the executable machine code may be integrated with the code of other programs, implemented as subroutines, by external program calls or by other techniques as known in the art.

The embodiments of the invention may be executed by a computer processor or similar device programmed in the manner of method steps, or may be executed by an electronic system which is provided with means for executing these steps. Similarly, an electronic memory means such computer diskettes, CD-Roms, Random Access Memory (RAM), Read Only Memory (ROM) or similar computer software storage media known in the art, may be programmed to execute such method steps. As well, electronic signals representing these method steps may also be transmitted via a communication network.

WHAT IS CLAIMED IS:

1. A system for teleconferencing comprising:

three or more user terminals, each having an audio input and an audio output;

a telecommunications network interconnecting said user terminals and operable to transport data to and from said user terminals;

separate modular mixing software for each respective user terminal, executing on said telecommunications network, and operable:

to receive separate audio signals from said audio outputs of the others of said user terminals; and

to combine said separate audio signals into a signal for said audio input of said respective user terminal which correlates to the needs of said respective user terminal.

2. A system as claimed in claim 1, further comprising:

modular connection management software for establishing interconnections between said three or more user terminals and said separate modular mixing software, including a connection proxy for each of said three or more user terminals and said telecommunications network; and

each of said connection proxies executing on said system and being operable:

to represent its owner's interests in managing the teleconference by recognizing the limitations of its resources.

3. A system as claimed in claim 2, further comprising:

a mapper for locating said separate modular mixing software for each respective user terminal for execution on different routers of said telecommunications network, trading off delay time in communicating data between routers with computational power available in order to maintain quality of service.

4. A system as claimed in claim 3, wherein said telecommunications network comprises multiple telecommunications networks with varied transport media and protocols, each of said multiple telecommunications networks having its own connection proxy.

5. A system as claimed in claim 4, further comprising:

negotiation management software including a negotiation agent for each of said user terminals and said multiple telecommunications networks, each of said negotiation agents being operable:

to execute on said system; and

to representing the interests of each of said three or more user terminals in negotiating communication over said telecommunications network;

said negotiation management software being operable:

to identify negotiation agents participating in a negotiation;

to implement a negotiation discipline which allows each said participating negotiation agent to consider a communication contract and either accept or revise said communication contract; and

to respond to said negotiation being successful by executing said communication contract.

6. A system as claimed in claim 5, wherein said separate modular mixing software is operable to combine said separate signals into two or more audio channels which define a metaphorical physical space, each user terminal having a simulated position within said metaphorical physical space whereby individual users may be recognized by their particular position in said space.

7. A system as claimed in claim 6, wherein said mixer is responsive to a request from said respective user to emphasize a particular user's voice by amplifying the corresponding audio signal prior to combining.

8. A system as claimed in claim 7, wherein at least one of said user terminals comprises a personal computer having a stereo sound card and stereophonic speakers, and said respective mixer software is operable to combine said separate signals into two audio channels.

9. A system as claimed in claim 8, wherein at least one of said user terminals comprises a connection to a PSTN network via two monophonic telephone lines, and said respective mixer software is operable to combine said separate signals into two audio channels.

10. A system as claimed in claim 9, wherein each said connection proxy comprises:

multiple software agents each being operable to perform a specific task; and

a proxy object operable to instantiate particular ones of said multiple software agents in response to requirements of communications made over said telecommunications system.

11. A server for teleconferencing comprising:

means for interconnecting user terminals and transporting data to and from said user terminals;

means for executing separate modular mixing software for each respective user terminal, said separate modular mixing software including:

means for receiving separate audio signals from said audio outputs of the others of said user terminals; and

means for combining said separate audio signals into a signal for said audio input of said respective user terminal which correlates to the needs of said respective user terminal.

12. A method of teleconferencing comprising the steps of:

receiving, at a separate modular mixer representing a respective one of three or more user terminals and executing on a telecommunications network, separate audio signals from audio outputs of the others of said user terminals; and

combining said separate audio signals into a signal for an audio input of said respective user terminal which correlates to the needs of said respective user terminal.

13. A computer data signal embodied in a carrier wave, said computer data signal comprising a set of machine executable code being executable by a computer to perform the steps of claim 12.

14. A computer readable storage medium storing a set of machine executable code, said set of machine executable code being executable by a computer server to perform the steps of claim 12.

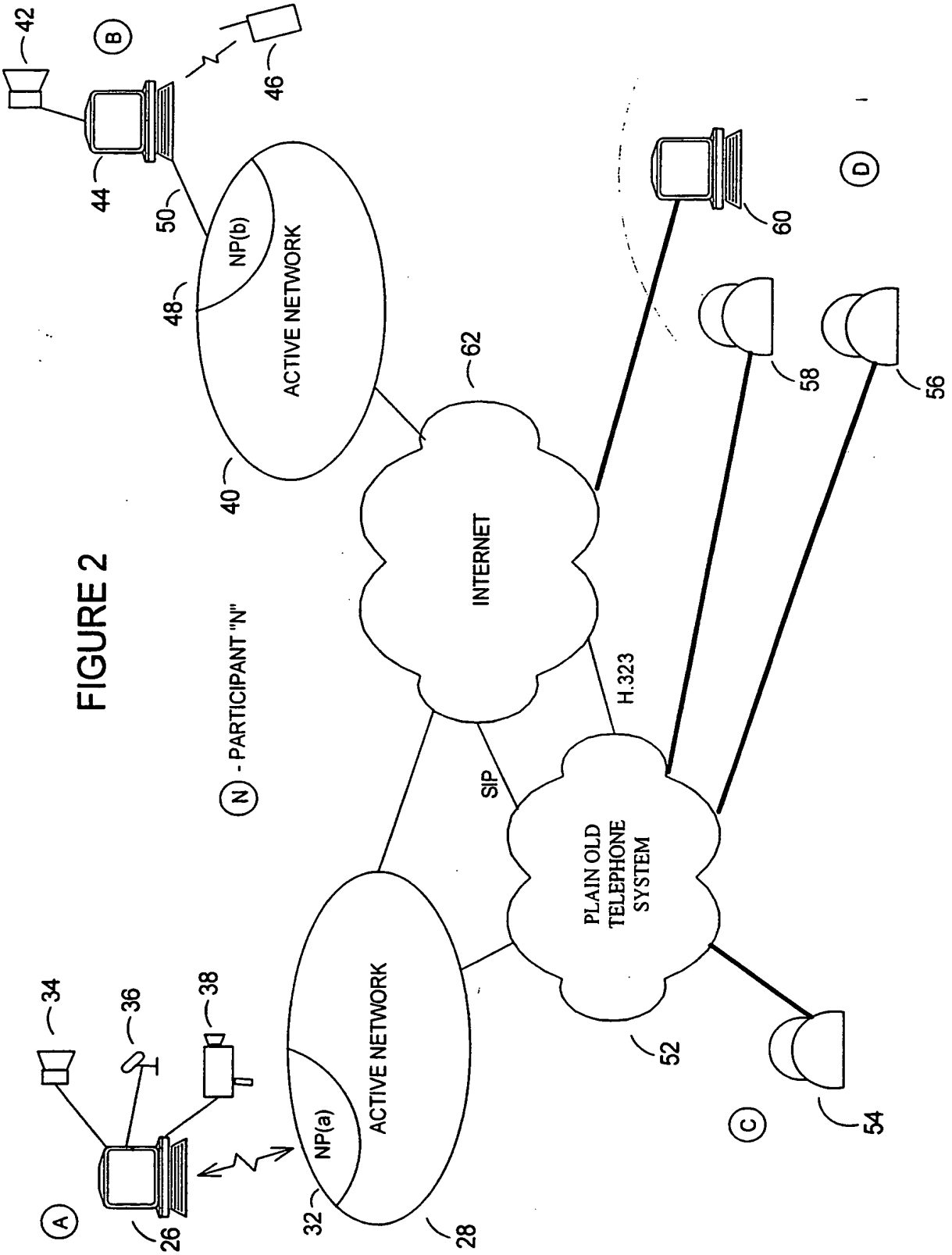
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FIGURE 2

PCT

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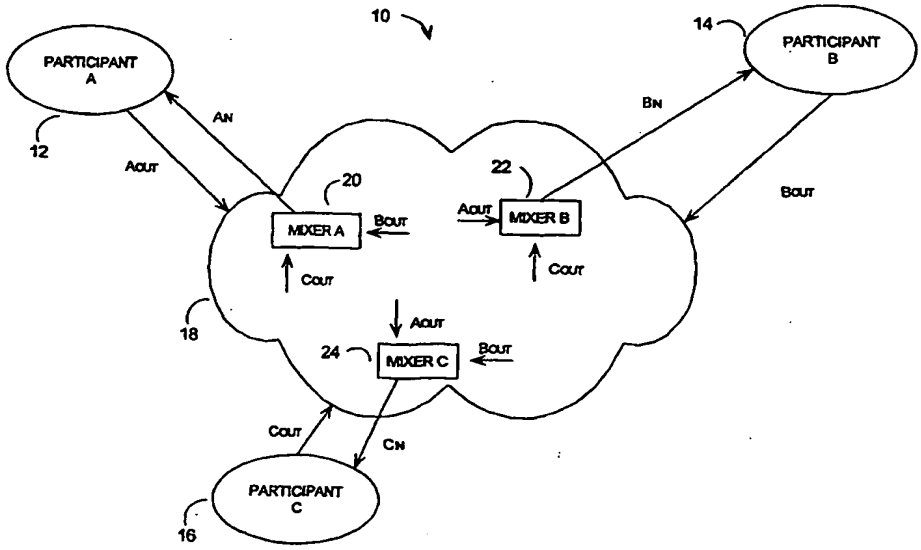

(57) Abstract

The present invention relates generally to telecommunications, and more specifically, to a system and method of teleconferencing. Existing telephony systems suffer from a number of problems including system complexity, limited access and implementation of services on fixed hardware which results in long time to bring new products to market. Internet applications implement teleconferencing on end user personal computers, without the network performing any processing of data streams or guaranteeing quality of service in the transmission. The invention provides for an intelligent server which executes a separate mixer for each user, where the mixer is dedicated to the resources available to that user. This allows for an open and flexible teleconference system which can operate over multiple networks.

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INTERNATIONAL SEARCH REPORT

Inte. ...nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
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B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 473 363 A (NG DENNIS ET AL) 5 December 1995 (1995-12-05) column 2, line 17 -column 3, line 10	1,11,12
A	US 5 596 635 A (RAO V R GOPALA) 21 January 1997 (1997-01-21)	
A	EP 0 680 190 A (AT & T CORP) 2 November 1995 (1995-11-02)	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 January 2000	25/01/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Vandevenne, M

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ɔnal Application No
PCT/CA 99/00875

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5473363 A	05-12-1995	CA 2169571 A	08-02-1996
		EP 0724806 A	07-08-1996
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US 5596635 A	21-01-1997	NONE	
EP 0680190 A	02-11-1995	CA 2143591 A	30-10-1995
		JP 7303147 A	14-11-1995

Strategy for Negotiation of Telecommunication Resources

The present invention relates generally to telecommunications, and more specifically, to a method and system of negotiating desired resources over telecommunication networks offering a variety of services and/or levels of service.

Background of the Invention

Conventionally, telecommunication networks were comprised of single Service Providers making a single service available to Users. However, telecommunication networks have evolved greatly over the last two decades, and continue to evolve, so that there are currently multiple providers offering multiple services on multiple levels. For example, the data transmission methods and protocols now employed include Internet Protocol (IP), asynchronous transfer mode (ATM), frame relay, and digital telephony. Similarly, in the long distance voice telephone market there is a large number of Service Providers who use various transmission means including analog, digital and digital compression methods, over wired, wireless, fiber optic and satellite transmission facilities. The networks of these Service Providers are typically interconnected with those of others to form larger, heterogeneous networks.

Determining the optimal means of communicating between two points over such telecommunication networks is a complex task, requiring consideration of the price, quality and availability of services, in view of the requirements of the communication desired and the generally conflicting interests (cost vs. price, network capacity vs. service levels, etc.)of the parties involved. While attempts have been made to provide systems to manage these complexities, the proposed solutions are inefficient and have shortcomings that limit their effectiveness.

In general, existing telecommunications systems offer a small number of finite, non-negotiable services, though they may allow users to select which of these finite services they desire. The Public Switched Telephone Network (PSTN), for example, offers a finite set of services which are controlled using a limited set of SS7 messages. Customers can subscribe to services over a predetermined time period, or request special services either through interaction with a telephone operator or mechanically by use of Interactive Voice Response (IVR) systems. Either way, the number of options available to the customer is very limited. Further, a customer generally can only select services directly from the Service Provider of the first link that they connect with, services on downstream links provided by other Service Providers are negotiated by the first link Service Provider.

Similarly, while the Internet provides an efficient network for transporting data packets, it is

not designed to provide end to end services with guaranteed performance levels. Typically, there is a static selection of services available to users, under predetermined terms and conditions. The performance level that a user may require is offered on a "best effort" basis and is not firmly guaranteed. As well, users communicating over the Internet must use protocols that are understood and supported by all the participants.

Voice and computer data were once carried on separate networks, although both are now generally transmitted digitally over the same networks. Because the requirements for voice and data transmission are so different, it is difficult to optimize the provision of both on a common network. Voice communication, for example, produces a steady stream of data at a fairly low rate, and rapid delivery is more important than accuracy. In contrast, data applications such as Web browsing generally produce bursts of data that are to be delivered accurately, and for which a delay of a second or two may be considered acceptable.

Other services may have different requirements for accuracy, delay and data rate, which characterize the Quality of Service (QoS) in a communication session. Ideally, a telecommunication Service Provider should provide a service which optimizes communication for a User's particular application and simultaneously optimizes the provision of that service over his own network along with services he is providing to other Users. Using traditional techniques, this would require the Service Provider to proactively offer a different Quality of Service for each new voice or data application that is developed.

Because Service Providers have limited knowledge of what applications their Users may be implementing, it is difficult for them to offer products which are tailored to those applications. It is also clearly impossible for Service Providers to anticipate the requirements of applications that have yet to be developed. Similarly, Service Providers are not generally aware of the computing power that a given User has, in terms of processing speed, memory capacity, software and operator expertise. Therefore, Service Providers generally provide products that serve the most common market, and possibly one or two major niche markets. Currently, Users must search for the Service Provider that offers products best suited to their needs, if one does exist. Users that have multiple needs may have to enlist the services of a number of Service Providers.

A conventional telephony network provides a fixed quality of voice service, called toll quality, at a pre-arranged price. Long-distance re-sellers may use digital voice compression to offer lower-cost long distance service at a reduced price, but again, this service offers a fixed quality at a pre-arranged price. Because competitors offer different voice quality, pricing and probability of call success, End Users can choose a Service Provider with a good reputation for

providing service, even when such a provider may charge a greater price than others, or End Users can choose a lower priced Service Provider, knowing that service levels may be less than optimal. This method becomes cumbersome when new services appear and the end user must select a Service Provider for each of his applications and track their performance or check their reputations by word of mouth.

The existing systems do not allow provision of diverse services with specific performance requirements. For example, remote surgery in which a physician uses a remote manipulator to perform surgery, could not be implemented with existing systems. This application would require very strict demands on both accuracy and timeliness together with a data rate sufficient for video. The consequences of the network failing to perform as required would be very serious.

Another example is Internet gaming, in which a number of players exchange small packets of information to update each other on their moves. Given how such games are typically implemented, this application calls for low latencies, but data rate requirements are light and a fairly high rate of packet loss can be tolerated as such game applications are generally designed to tolerate these packet losses.

Hence, a demand exists for systems and methodologies which allow users to tailor communication parameters to accommodate their specific needs. While attempts have been made to provide such systems, the present inventors are unaware of any that have been effective.

A number of existing systems are surveyed in the article, "Connection Establishment in High-Speed Networks", by Scott Jordan and Hong Jiang, IEEE Journal on Selected Areas in Communications, vol. 13, no. 7, September 1995 and the contents of this article are incorporated herein by reference. The models discussed in the article describe a large number of parameters that must be resolved between the participants, including: cell loss probability, delay jitter, end-to-end delay, average throughput, peak bandwidth, pricing, network congestion and degradation, and incentives to ease load management on the network. But the processes discussed by Jordan et al. require all parties to agree on values for all parameters of the communication in a single stage. The present inventors have determined that, as the number of participants and complexity of their requirements grow, the likelihood of complete agreement diminishes, and no mechanism to resolve disagreement is presented by Jordan et al. Further, if the parties fail to come to terms, it is very difficult to determine why an agreement could not be reached.

Jordan et al. describe several "two stage" methodologies which include: a first stage in which "the user agent characterizes the information streams that will be transmitted"; followed by a second stage in which the network offers a rate schedule from which the calling party selects their

preference.

While these processes appear to be an advance over previous systems, they are best described as offer-acceptance models. The user remains at the mercy of the service provider who may continue to offer only services that optimize his own resources, as telecommunication providers have done in the past. Further, these systems have no incentive for the service provider to offer the differentiation of services that today's applications require. As well, the first stage described by Jordan et al. is in essence an initialization stage and the offer and acceptance takes place in the next stage, so all of their methods are essentially single stage agreements.

On page 1155 of the Jordan et al. article, a reference is made to a "distributed iterative negotiation process" described in , "A New Approach To Service Provisioning In ATM Networks", by S. H. Low and P. P. Varaiya, IEEE Transactions on Networking, Vol. 1, p.p. 547-553, 1993. However, Low et al. simply describes an offer - acceptance model. Further, by "iterative", Low simply means that the network updates its rates periodically, and re-negotiates with the users while their communications are active.

The article, "Connection Establishment Protocol Based on Mutual Selection by Users and Network Providers", Nagao Ogino, ACM, 1998, presents a similar methodology in which a number of service providers bid on the provision of communication services defined by the user. This methodology requires that all parameters be specified and addressed in a single stage and is merely a bid-award system.

No instruction is provided in Jordan et al. or Ogino as to how these methods may be applied to a general case. For example, how are the logistical difficulties of establishing a video conference between six parties to be addressed? This would require at least six simultaneous and interactive negotiations between the respective parties and their service providers, as well as interconnections between these service providers. Each of these negotiations would have to resolve a large number of parameters, possibly including: latency; average bandwidth; peak bandwidth; pricing; cost sharing requirements; encryption and video compression format. With so many parameters (degrees of freedom), it would be very difficult to find terms that all parties would agree to, and such conditions may not exist at all. Therefore, in order to be effective, some means of assuring convergence and to address disagreements is required.

There is therefore a need for a method and system of negotiating resources over telecommunication networks offering a variety of services. This method and system must be provided with consideration for the problems outlined above.

Summary of the Invention

It is therefore an object of the invention to provide a novel method and system of negotiating resources over telecommunication networks offering a variety of services which obviates or mitigates at least one of the disadvantages of the prior art.

According to one aspect of the present invention, there is provided a method of establishing communication between at least two entities, where the characteristics of said communication are defined by a set of parameters, said method comprising the steps of:

(i) arranging said set of parameters into a hierarchy of at least two stages with ones of said parameters in one of said at least two stages;

(ii) negotiating, for each stage in turn, values for said parameters in said stage with each of said at least two entities to produce a set of agreed parameter values for each said stage; and

(iii) responding to agreement at all stages by establishing said communication between said at least two entities according to said agreed values for said parameters.

According to another aspect of the present invention, there is provided a telecommunications system comprising:

a First User Interface;

a Second User Interface;

a telecommunications network operable to interconnect said First User Interface with said Second User Interface;

each of said First User Interface, Second User Interface and said telecommunications network having an Agent to represent its respective interests in negotiating a communication between said First User Interface and said Second User Interface and each said Agent being operable to agree on values with each other Agent for a set of parameters arranged in a hierarchy of stages to define a desired communication between said First User Interface and said Second User Interface.

According to yet another aspect of the present invention, there is provided a telecommunication method for negotiation between participants to establish a desired communication through a telecommunication network, the communication defined by a set of parameters arranged in a hierarchy of stages, the method comprising the steps of, from the highest stage to the lowest stage in turn:

(i) negotiating and agreeing values with said participants for the parameters of a stage under consideration;

(ii) if values for one or more parameters in said stage under consideration cannot be agreed,

terminating said negotiation and notifying said participants accordingly;

(iii) if values for parameters in the stage of step (i) are agreed, performing steps (i), (ii) and (iii) for each succeeding stage in said hierarchy;

(iv) when values for all parameters in all stages have been agreed, said participants establishing said desired communication.

In the event that negotiations fail at a stage, a participant can change the value of a parameter in a previously agreed stage and can restart the negotiation at that stage in an attempt to resolve the failure.

Further, participants can compete to establish the desired communication and this competition can occur at each stage. Participants who fail in the negotiations at a stage are removed from subsequent negotiations at subsequent stages.

Various negotiating disciplines can be employed to negotiate the stages, including a Round Robin negotiating discipline or others as will occur to those of skill in the art.

Brief Description of the Drawings

Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

Figure 1 shows a flow chart of a method in accordance with an embodiment of the invention;

Figure 2 shows a block diagram of the entities of a telecommunications system in accordance with an embodiment of the invention;

Figure 3 shows a schematic diagram of the interactions of the entities involved in the telecommunications system of Figure 2 ;

Figure 4 shows a flow chart of the generic method used by the Negotiation Manager shown in Figure 3;

Figure 5 shows a flow chart of a method used by the Telecommunication Network's Agent shown in Figure 2; and

Figure 6 shows a flow chart of a method used by the First User's Agent shown in Figure 2;

Figure 7 shows a flow chart of the staged negotiation method in accordance with an embodiment of the present invention; and

Figure 8 shows a flowchart of the restarting of a negotiation after the unsuccessful termination of a negotiation.

Description of the Invention

A simplified view of a methodology in accordance with an aspect of the present invention is shown in Figure 1. This Figure presents a method of establishing communication between a first entity and a second entity, where the communication is defined by a set of parameters. As will be discussed in more detail below, negotiation between the first entity and the second entity occurs in stages, each stage having a subset of the set of parameters to be negotiated. The process commences with the first stage wherein values for one or more parameters are negotiated between the entities at step 2. A determination is made at step 4 as to whether values for all parameters being negotiated in that stage have been agreed to by the entities. If the values have not been agreed, the negotiation in step 2 repeats. If values have been agreed for all parameters of a stage, a determination is made at step 6 as to whether any more stages exist to be negotiated. If one or more stages do exist to still be negotiated, at step 8 the next stage is selected and the negotiation of step 2 is performed for the parameters of that stage. If at step 6 it is determined that no more stages exist to be negotiated, the process proceeds to step 9 where the desired communication is established and the process completes. As described in more detail below, various mechanisms can be employed if the negotiation process of step 2 does not result in a convergence between the entities of the values for the parameters of a stage.

The phrase "participant" is used herein to describe hardware or software that represents any party having an interest in the parameters for the communication. Such parties can include end users, their service provider or providers, and interconnecting communication providers. End users will have terminal devices which allow the user to send and receive audio, video, data or other similar information, and such terminal devices can be a telecommunication interface such as a telephone, personal computer, personal digital assistant, cellular telephone, pager, fax machine or other devices as will occur to those of skill in the art. Service providers can communicate with the end users via dial-up, cable or wireless modems, or using technologies such as ISDN (integrated services digital network), ADSL (asynchronous digital subscriber line), ATM (asynchronous transfer mode) or frame relay, for example. These devices and systems are secondary to the invention and other suitable means for Service Providers to communicate with end users within the scope of the present invention will occur to those of skill in the art.

The parameters that define the communication will depend on the nature of the communication that is desired. In the simple case of a voice call, the parameters can include: the price of the call, who pays, and the quality of the call. More complex communications will include other parameters, as will be apparent to those of skill in the art, some of which are identified

hereinafter. Even in a simple case, the present inventors believe that it is easier and more advantageous to negotiate values for the set of parameters in multiple and successive stages. In more complex cases of course, there may be many stages. The number of stages and which parameters are negotiated during which stage, will depend on the priorities and goals of the participants. Once the values for the parameters have been agreed to, the connection can be executed according to those parameter values.

As explained above, there is a growing demand for diverse services, which require telecommunication service providers to allow service parameters to be tailored to the specific requirements of the users. Even simple applications can result in very complex negotiations, which cannot be handled effectively by the existing methods. For example with existing methods, when a very large number of parameters and degrees of freedom need to be considered, it can require too long to perform the negotiation, participants may not be pleased with the outcome, and there is no guarantee that an agreement will ever be reached.

Hence, the present invention separates negotiation of a communication into stages, where values for smaller sets of parameters are negotiated at the different, successive stages so that progress towards agreement is logical and steady. This reduces the level of complexity at each stage, so that there are fewer tradeoffs and alternatives to be considered during negotiation, and analysis of negotiations which failed or which produced undesirable results, are easier to perform.

The use of multiple stages allows communications to be managed, organized to be efficient and to terminate negotiations with a successful result. The logical division of the parameters to be negotiated in a stage makes the resolution of the communication much more straightforward and increase the likelihood of success. Further, it will take less time to find the values for the parameters that all participants will agree to, without wasting time at a lower (more specific parameters) level if agreement is not going to be reached at a higher (general, or non-negotiable, parameters) level.

The invention provides for the "categorization of concerns", in that some terms can be more important to overall success ("deal breakers") and/or some terms are dependent upon others. It does not make sense to negotiate less important terms if one or more deal breaker terms cannot be agreed. For example, an application may require a guaranteed minimum data rate and, if such a rate cannot be agreed, then there is no sense in attempting to negotiating cost. Similarly, it does not make sense to negotiate a term whose relevance or meaning depends from another term before that other term has been agreed. For example, the cost that a calling party is willing to accept will depend upon the type of call to be established. So, the parameters whose values are to be

negotiated are arranged in a multilevel hierarchy, each level being negotiated as a stage.

The invention also provides another feature that Internet Service Providers (ISPs) can use to sell their services. Users who are accustomed to the high reliability of existing PSTNs could be hesitant to use the Internet for all of their communications unless there is a way of offering similar convenience and reliability. The invention enables such an application. As noted above, it is preferred that automated software agents represent the participants in the negotiation and configuration of a software agent to mimic a traditional PSTN telephone can be accomplished easily.

Finally, preferably, the present invention is implemented as an open system, where third parties are able to contribute to the body of related software. In such a system, the use of the multiple stages makes it easier to write new negotiation strategies and other software utilities.

The present invention can include additional features which offer even greater improvements in effectiveness over previous methods. As noted above, negotiations may rise exponentially in complexity with the numbers of parameters and participants. The invention manages this complexity by breaking the negotiation down into smaller stages which can be easily monitored. The method of the invention can assist in obtaining convergence because the negotiation can now be described in manageable terms and status information fed back to the participants. In the simple case, the invention can advise all participants of:

(i) which parameters are to be negotiated in which stage;

(ii) which values have been agreed to; and

(iii) the status of the present stage of negotiation.

In a present embodiment, the communication proposals pass through the trusted domain of a Negotiation Manager, described below, so that the progress of the negotiation can be monitored with confidence, and convergence to a negotiated agreement is encouraged. A proposal comprises a set of values for the set of parameters in a stage, the set of values being those that a participant can, or is willing to, accept. The invention allows participants to know what parameters have been resolved so far so that the participant can decide how to proceed.

As an example, an agent may repeatedly reject a communication, which is being negotiated, because the proposal includes a certain compression algorithm for which the participant does not have the necessary software. When a participant receives the feedback information identifying why the negotiation failed, the participant can obtain the necessary software, if desired, to allow future communications requiring the compression algorithm to proceed. Without the feedback provided by the invention, the participants often would never have known why the communication

was not established.

As well, participants can be advised as to what the contentious parameters/issues are on a per stage basis. For example, rather than report that ten parameters are unresolved, the present invention can report that the parameters of stages 1 and 2 have been resolved, while one parameter (e.g. total permitted end to end latency) has not been resolved in stage 3 and that, because of this, the remaining parameters defined in stages 4 and 5 have not yet been considered. Having participants better informed can expedite agreement and user satisfaction.

An end user may wish to focus on particular parameters and does not want superfluous disagreements to cause repeated failures. The present invention allows the user to identify certain parameters as critical (e.g. deal breakers) and others as merely desired, or "don't care", and the feedback that the present invention provides makes it easier for participants to identify why a certain communication cannot be resolved and to attempt to correct the problem.

If the participants in a negotiation fail to reach an agreement, they generally wish to determine why, so that the problem can be overcome for the present situation and avoided in the future. Such 'forensic analysis' is simplified by breaking the negotiation down into stages. Specifically, the Negotiation Manager can return audits to the participants identifying the parameter values that were modified, and by whom, in each stage.

In an ideal case, a failure to reach an agreement in one stage can be examined to determine the cause of failure so that remedial action can be taken to permit the communication to be successfully completed. This remedial action can consist of reinitiating a preceding stage of the negotiation with an adjusted set of parameter values, selected in view of the determined cause, and which will allow convergence to occur at a subsequent stage. As an example, a communication may be proposed as a video call, for which a 'type of connection' parameter value is set in stage 1, and for which stage 2 has a dependent 'deal breaker' parameter which is a minimum data rate of 4Mbits per second. In such a case, stage 1 may be successfully negotiated with the parties agreeing to the video call, but in stage 2 agreement cannot be reached if such a data rate cannot be provided by a participant. With forensic knowledge of the failure at stage 2, stage 1 can be re-initiated with the value for the type of connection parameter downgraded to a degraded type of video call (slow scan video for example or one employing a high ratio data compression system), allowing a data rate of less than 4Mbits per second to be accepted in stage 2.

For such forensic analysis, there are three main situations of interest:

(i) where the discrepancies between parameter values in proposals are very large, it is easy to identify why the negotiation failed. The Negotiation Manager can simply compare consecutive

proposals and advise which parameter values were changed;

(ii) smaller conflicts between proposals of participants are harder to detect. In an embodiment of the invention, the Negotiation Manager can monitor the proposals, storing the last *n* set of parameter values from each participant and advising the participants if repetition occurs. If the proposal has the same state (set of parameter values) at a given point in its circulation through the participants that it had for a previous negotiation round, some action must be taken to address the problem, or the negotiation will not converge; and

(iii) it is also difficult to detect the situation wherein sets of parameter values from participants are very close and yet the proposals do not converge, but follow a cyclic pattern that only returns to the same state after a large number of iterations (i.e. – proposals follow a pattern of states such as A-B-C-D-E-A-B-C-D-E, etc.). In such a case, the Negotiation Manager can simply end the negotiation after a finite number of iterations, and report to the participants on the states of past proposals. Alternatively, the Negotiation Manager can identify the parameters that were being disputed or manipulated from stage to stage. Techniques for identifying patterns, loops and other anomalies in the proposal history produced by the Negotiation Manager are known in the art and will not be further discussed herein.

The preferred negotiation system of the invention is presented as a block diagram in Figure 2. In this example, telecommunication system 10 consists of a First User Interface 12 and a Second User Interface 14, interconnected by a telecommunications network 16. The First User Interface 12 and Second User Interface 14 can be, for example, telephones, cellular telephones, personal digital assistants, personal computers or servers which produce and/or consume data. The telecommunications network 16 has at least one transmission means and protocol, which will be described in detail hereinafter.

First User Interface 12 will have a First User Agent 18 which represents the interests of the First User Interface 12 in negotiating a communication between itself and the Second User Interface 14. Similarly, Second User Interface 14 has a Second User Agent 19, which represents the interests of the Second User in negotiating the communication and the telecommunications network 16 has a telecommunications network agent 20 which represents the interests of the telecommunications network 16 in negotiating the communication.

The negotiation of the terms of communication is administered by a software agent called the Negotiation Manager 22. Negotiation Manager 22 can reside anywhere in the system 10, though in a simple implementation, it will reside somewhere in the telecommunications network 16 which is the First User's Service Provider.

Preferably, the Negotiation Manager 22 is operable to:

1. identify participating agents in a negotiation;
2. implement a negotiation discipline which allows each participating agent to consider a proposal and either accept the proposal or amend the values of one or more parameters of the proposal, and do so in a trusted environment;
3. respond to the negotiation being successful in a stage by proceeding to next stage or by executing the proposal to provide the communication if all stages have been successfully negotiated;
4. identify loops, cycles and other anomalies in the proposal history;
5. determine whether the negotiation will converge;
6. return audits to the participants identifying the values of parameters that were modified, and by whom, from stage to stage;
7. detect whether a participant has violated the rules of the negotiation;
8. ensure termination within a limited number of rounds if convergence has not yet occurred; and
9. provide forensic information to participants if the negotiation terminates without convergence.

Broadly speaking, system 10 provides a flexible telecommunications system for resolving contention for network resources. System 10 is flexible in that new services and features developed by outside parties can be implemented in the negotiation. In current telecommunication systems, all services are provided and controlled by the telecommunication system providers, which limits the services available and impedes the provision of new services. In system 10, an End User, Negotiation Manager or other Network Entity with an interest in the negotiation, can obtain new negotiating disciplines or software agents developed by themselves or outside parties and implement them in the negotiation. Further, an End User of a Service Provider can define a set of parameters for a new service, feature or application in a timely and efficient manner. Details of such options will be described in greater detail herein after.

System 10 of the invention permits multiple participants to negotiate the terms of a given communication. The requirement for this functionality is clear, as a communication may have to pass through two, three or more telecommunication providers in traversing a broad geographical area. It is in the best interest of all the Network Entities involved in the communication to also participate in the negotiation.

This generalization also allows communications which have multiple End Users, such as conference calls, to be negotiated with all of the End Users and their associated Service Providers participating.

System 10 of the invention encourages Service Providers to offer a greater variety and flexibility in their services, by improving the efficiency of their networks accordingly. In turn, this increased variety and flexibility allows the End User to negotiate the services that he wants, rather than being forced to choose between limited services from the Service Provider to which he subscribes, or having to seek out a new Service Provider that offers the services he requires.

System 10 resolves contention between End Users by making a variety of data, voice and other telecommunication services available that are suited to varying applications. System 10 also provides incentives, such as reduced prices and improved overall network capacity utilization, encouraging use of available resources rather than insisting on the highest quality. By making the provision of those services open to real time negotiation, the participants are able to reach a mutually agreeable result which might have been impossible to otherwise achieve.

As described above, the invention allows these improvements by providing a system wherein each interested party can have a software agent which negotiates on his behalf. As a minor issue, this requires that a convention for negotiation be established that all the software agents can understand, though the particular nature and parameters of such a convention does not limit the invention. In the event that a user interface is not sophisticated enough to directly support an agent, an agent can be created for that user interface, as needed, at another location in system 10. For example, if in Figure 2 second user interface 14 is a conventional telephone, second user agent 19 can be implemented by network 16 or negotiation manager 22 and can utilize a fixed set of requirements and capacities which have been predetermined for conventional telephones.

Figure 3 shows the interactions between the participants and the Negotiation Manager in the present invention. In the Figure, each interested party in the negotiation is shown as a participant 24. In a simple implementation as described with respect to Figure 2 above, participants 24 will include the First User's Agent 18, Second User's Agent 19 and the Telecommunication Network's Agent 20. While Second User's Agent 19 is not required for conventional models of a voice telecommunication where the originating caller assumes the cost of the service, Second User's Agent 19 will allow the Second User to assume all or part of the cost of the telecommunication in other cases. More importantly, it would allow the communication to be negotiated with consideration for the interests of the Second User Interface 14. For example, if Second User Interface 14 does not have the modem speed of the First User Interface 12, there is not any benefit

to negotiating a high-speed connection between the First User Interface 12 and the Telecommunication Network 16.

Similarly, if the Telecommunication Network 16 consists of a number of ATM, long distance or frame relay providers, it may be advantageous to include a software agent for each respective telecommunication provider in the negotiation as well. Therefore, any entity in the telecommunication system 10 which has an interest in the outcome of the negotiation, may be a participant 24 in the negotiation.

The Participants 24 communicate with the Negotiation Manager 22 by passing a proposal 26 back and forth using agreed default communications protocols. At a minimum, a proposal 26 includes a definition of the communication sought with a set of parameters for defining the communication, the parameters arranged in hierarchical stages, as discussed above.

In general, a negotiation will consist of a single proposal 26 that each participant 24 is free to inspect and modify. Use of a single proposal 26 avoids problems that could be experienced with multiple proposals which require additional overheads of coordination and time stamping.

As well, because proposal 26 is a relatively small data packet, little real time is lost in transferring it from one participant 24 to another. The User may also have some control over the size of proposal 26 by his choice of negotiating strategy and parameters. The contents of this proposal 26 will be detailed herein below.

Negotiation Manager 22 will employ a negotiation discipline 28 according to a set of discipline parameters 30. The invention will be described herein below with respect to a specific example of a negotiation discipline 28, but the invention is independent of the actual negotiation discipline 28 employed.

As noted above, the invention is not limited by the physical location of the Negotiation Manager 22. In general, it is desirable that the Negotiation Manager 22 be trusted by all parties, and/or reside in a secure location, but even this is not necessary if participants 24 secure themselves within their negotiating preferences. For example, a participant 24 could restrain his set of values in proposal 26 to be revocable, allowing himself a last-look prior to commencing execution of a negotiated proposal 26. Other methods of securing, for example, by use of cryptographic signatures or an authentication list, are known in the art.

Because the location of Negotiation Manager 22 is not restricted, it can be provided by a network Service Provider, the User himself, or a third party. This flexibility is one of the benefits of the invention, in that it makes this an open system. A third party can create a Negotiation

Manager 22 or a negotiation discipline 28 and make it available to all interested Users and Network Entities on the telecommunication system 10.

This openness will allow the system 10 of the invention to mature very quickly by the addition of new Negotiation Managers 22 and negotiating disciplines 28 with new features.

A simple flow chart of the Negotiation Manager 22 operation is presented in Figure 4. The Negotiation Manager 22 identifies all of the participants 24 in the negotiation at step 32, implements the negotiation discipline 28 at step 34, determines if the negotiation has been successful at step 35 and, if the negotiation is successful, executes the contract that results from the negotiated values for the set of parameters at step 36. If at step 35 Negotiation Manager 22 determines that the negotiation has been unsuccessful, forensic information is returned to the participants at step 37 to enable them to re-initiate the negotiations, if desired, with a revised set of parameter values in an attempt to converge the negotiation.

The identification of the participants 24 at step 32 can be performed in a number of manners. In a simple implementation with three participants 24, namely the First User's Agent 18, Second User's Agent and the Telecommunication Network's Agent 20, the participants 24 will be identified in the initial proposal 26 created by the First User's Agent 18 when he initiates his request for communication with the Second User Interface 14. In such a case, the initial proposal 26 will identify the First User Interface 12 as the source of proposal 26 and the calling party, the Second User Interface 14 as the called party, and the Telecommunication Network 16 as the Service Provider.

In the more general case, the initial proposal 26 will still identify the First User Interface 12 as the source of the proposal 26 and the calling party, and the Second User Interface 14 as the called party, but the identification of participants 24 at the Telecommunication Network 16 level may be left to the Negotiation Manager 22. Having Negotiation Managers 22 identify Service Providers from a database will give the Service Providers motivation to actively seek out Negotiation Managers 22, because if a Service Provider is not on a Negotiation Manager's 22 database, he will not be advised of any negotiations by that Negotiation Manager 22. Methods for creating, accessing and maintaining such a database of Service Providers are well known in the art.

In the embodiment shown in Figure 3, it is sufficient that the negotiation discipline 28 consist of a strategy which allows a proposal 26 to be negotiated that is satisfactory to each participant 24. In the simple case illustrated in Figure 2, the negotiation discipline 28 can consist of the Negotiation Manager 22 transferring the proposal 26 back and forth between the First User's Agent 18, Second User's Agent 19 and the Telecommunication Network's Agent 20 without any

interference or active participation by the Negotiation Manager 22. In such a case, the First User's Agent 18 or Second User's Agent 19 can "time out" if a successful contract 26 is not negotiated within a specific time period, in order to halt the negotiation. Other negotiation disciplines 28, such as round robin bidding, or other suitable strategies, can be employed in circumstances with more participants or wherein more complex negotiations, such as negotiations allowing trade-offs between cost and service qualities, are appropriate. The present invention is not particularly limited to any particular negotiation discipline and appropriate disciplines will be apparent to those of skill in the art.

If the initial proposal 26 prepared by the First User's Agent 18 is acceptable to the Telecommunication Network's Agent 20, then the Telecommunication Network Agent 20 can approve the proposal 26 and return it to Negotiation Manager 22 unmodified which will then forward the proposal 26 to the Second User's Agent 19 to be considered. Details on how the Telecommunication Network's Agent 20 analyses the proposal 26 and responds will be described with respect to Figure 5 herein below.

At step 36, the Negotiation Manager 22 determines whether the proposal 26 has been successfully negotiated, and if so, allows the contract defined by the negotiated proposal 26 to execute. The successful negotiation of the proposal 26 may be indicated by setting a flag or bit in the proposal 26 or by any other suitable means as will occur to those of skill in the art.

Figure 5 describes the broad operation of Telecommunication Network's Agent 20 in the form of a flow chart. As indicated above, the purpose of the Telecommunication Network's Agent 20 is to represent the interests of the Telecommunication Network 16 in negotiating a communication between the First User Interface 12 and the Second User Interface 14. As the Telecommunication Network 16 has at least one telecommunication means and protocol at its disposal, it may want to negotiate to optimize efficient use of its resources.

Operation of the Telecommunication Network's Agent 20 is straightforward. At step 38, the Telecommunication Network's Agent 20 receives the proposal 26 from the Negotiation Manager 22. On the first iteration of a simple implementation as described with respect to Figure 2 above, this proposal 26 will contain the information supplied by the First User's Agent 18 and described above. The Telecommunication Network's Agent 20 inspects the contents of this proposal 26 at step 40, and determines whether it is acceptable or not.

If the terms of the proposal 26 are not acceptable, the Telecommunication Network's Agent 20 modifies the values of the set of parameters of the proposal 26 to terms it would find acceptable, at step 42. The modification of the terms of proposal 26 can include an outright rejection of the

communication, for example in the case of the network not having capability to implement the communication, or can be an adjustment of one or more parameters to values better suited (on an economic basis, or a network utilization basis, etc.) to network 16, The modified proposal 26 is returned to the Negotiation Manager 22 at step 44. Negotiation Manager 22 can, depending upon the negotiation discipline employed, either return it to the First User's Agent 18 for consideration of the new terms or forward it to the Second User's Agent 19 for consideration before returning it to First User's Agent 18.

In a simple case where the Telecommunication Network 16 has a very limited set of resources, the Telecommunication Network's Agent 20 may comprise a simple algorithm which generates new proposal 26 terms by referring to a database of resources and standard rates.

In a more sophisticated implementation, the Telecommunication Network's Agent 20 may comprise a rules-based agent that optimizes use of a continuum of resources. For example, if the Telecommunication Network 16 has access to ATM (Asynchronous Transfer Mode) services, it can offer Constant Bit Rate (CBR) transmission on a complete continuum from 10 Kb/s to 10 Mb/s, with a rate corresponding linearly to the traffic level. In such an arrangement, the Telecommunication Network's Agent 20 would have to consider its current traffic capacity, load, expected traffic and cost, in determining a counter offer that optimizes use of its resources. The implementation of such resource management methods is within the ability of one skilled in the art and is not discussed further herein.

If the terms of proposal 26 are determined to be acceptable at step 40, then the Telecommunication Network's Agent 20 accepts the proposal 26 at step 46 and returns the proposal 26 to the Negotiation Manager 22 at step 44. As noted above, a bit, flag or other indicator is included in the returned proposal 26 to advise Negotiation Manager 22 that the proposal is acceptable to First User's Agent 18.

Figure 6 is a flowchart illustrating the broad operation of First User's Agent 18 and, as will be apparent to those of skill in the art, the operation of Second User's Agent 19 is similar. This flow chart illustrates the operation of the agent in response to a returned proposal 26, but the operation of Agent 18 in creating the original proposal is similar and will be apparent to those of skill in the art.

In broad terms, the First User's Agent 18 operates in a very similar manner to that of the Telecommunication Network's Agent 20. As noted above, the purpose of the First User's Agent 18 is to represent the interests of the First User Interface 12 in negotiating a communication between the First User Interface 12 and the Second User Interface 14. As the computational and

communication resources and constraints of the First User Interface 12 may only be known to itself, it may wish to negotiate a communication means and protocol that makes best use of its resources in view of the particular application that it is implementing. For example, these resources and constraints can include processing speed, memory capacity and modem speed which can result in particular requirements and/or wants in the communication including minimum and maximum data rates, latency, frame or bit error rates, etc.

Operation of First User's Agent 18 commences at step 48 when the First User's Agent 18 receives the modified proposal 26 from the Negotiation Manager 22. In the some implementations, the First User's Agent 18 may not have the functionality to initiate a communication negotiation. In the case of the First User's Agent 18 not having the functionality to generate an initial proposal 26, the initial proposal 26 may be generated by another party in response to a request from First User Interface 12, or may be generated as a standing order by the Telecommunication Network's Agent 20 when the First User Interface 12 logs on to the Telecommunication Service provided by the Telecommunication Network 16. Other similar methods for establishing an initial proposal will be apparent to those of skill in the art.

The First User's Agent 18 inspects the contents of this proposal 26 at step 50, and determines whether it is acceptable or not. If the terms of the proposal 26 are not acceptable, the First User's Agent 18 modifies the values of the set of parameters of proposal 26 to terms it would find acceptable at step 52, or indicates an outright rejection of proposal 26 and returns proposal 26 to the Negotiation Manager 22 at step 54.

In a simple case the First User's Agent 18 may have a pre-defined set of limits that the First User Interface 12 does not wish to exceed. For example, such limits can include: not accepting charges for any incoming calls (in which case the proposal can be modified to include an outright rejection of such a proposed call), not exceeding the transmission rate of First User Interface's 12 modem, or not accepting voice communication with less than toll quality. If a value of a parameter of an incoming contract 26 exceeds any of these limitations, which can be identified with a simple logic test, a modified proposal 26 is generated which changes the parameter value, or values, so that they fall within the desired bounds or to reject the proposal. The First User's Agent 18 can comprise a simple algorithm which refers to a database of resources and preferences to prepare suitable changes to parameter values.

In a more sophisticated implementation, the First User's Agent 18 can comprise a rules-based software agent that optimizes use of a continuum of resources, in the same manner as the Telecommunication Network's Agent 20 described above. The First User's Agent 18 can, for

example, negotiate the communication with consideration for the particular application, and the computation and communication parameters of the First User Interface 12. These preferences may correspond to end-to-end telecommunication parameters such as peak cell rate (PCR), tolerable cell delay variation (CVDT), cell transfer delay (CTD), cell loss ratio (CLR) and peak-to-peak delay variation (CDV). Such parameters are generally used in ATM to specify the quality of service (QoS) that a telecommunication service provides. Clearly, the invention may be applied with various ones of these parameters, or different parameters known in the art, such as mean opinion score (MOS). Other subject measures are also possible with appropriate mappings as will be apparent to those of skill in the art.

If the terms of the proposal 26 are determined to be acceptable at step 50, then the First User's Agent 18 indicates its acceptance of the proposal 26 at step 56 and returns it to the Negotiation Manager 22 at step 54. As noted above, proposal 26 can have a bit or a flag set to indicate that it is acceptable to First User Interface 12. The process repeats with Second User's Agent 19 until all parties have agreed to the same set of terms in proposal 26 or until the negotiation is terminated.

Certain interfaces, such as a conventional telephone, will not have the internal operability for a software agent, so they can be assigned a software agent by the Negotiation Manager. Similarly, a user with a software agent who is remote from his terminal, may access his agent remotely, for example, by entering a calling card number at a pay telephone. The system is operable to then seek out the user's negotiation agent, and the user will obtain, at that telephone, all of the features and preferences he had subscribed to, presuming they can be operated on the telephone, such as call waiting.

Figure 7 presents a more detailed flow chart of the present invention. The process begins at step 100 wherein a set of parameters, appropriate to the desired type of communication, is determined. This set of parameters is arranged in a hierarchy of stages, depending upon the relative importance of the parameters (e.g. – deal breakers, desired parameters or "don't cares") and their inter-dependencies, if any. At step 104, an initial set of values for the parameters is established and the proposal is transferred to the Negotiation Manager. In this example, the Agent for the participant desiring to establish the communication has created the initial proposal, but it contemplated that in other circumstances Agents of other participants, such as the Agent of the called party or the Agent of one of the participating Service Providers can prepare the initial proposal.

Further, in this example the initial set of values for the parameters includes values for parameters in all stages. However, it is contemplated that, in other circumstances, initial values will only be created for the first stage and initial values for subsequent stages will be created once values for the preceding stage have been agreed.

Finally, step 104 also includes the transfer of the initial proposal, with initial values for at least one stage, to Negotiation Manager 22 (except in cases where Negotiation Manager 22 itself created the initial proposal).

Next, a test is performed at step 106 to determine the next stage, if any, which needs to be negotiated and, assuming that one or more such stages exist, at step 110 a first participant is selected to receive and consider the proposal. The proposal is transferred to that participant where it is considered at step 114 and any parameter values which are unacceptable to that participant are modified by the participant and the proposal, with amendments if any, is returned to the negotiation manager 22 at step 118.

At step 122, a determination is made as to whether any participants remain who have not yet reviewed the proposal. If such participants exist, the process returns to step 110 where the next such participant is selected. If at step 122 no such participant exists, the process proceeds to step 126 where a determination is made as to whether an agreement of the parameter values of the present stage has been achieved. If agreement has been reached, the process returns to step 106 where the next stage, if any, is selected and steps 114 through 126 are performed again.

If no agreement has been reached at step 126, a determination is made at step 130 as to whether a negotiation limit has been reached. As mentioned above, a negotiation limit can be an absolute time limit, a count of negotiation rounds, recognition of the occurrence of a cyclic in the negotiations or any other suitable metric for determining that convergence of the negotiations of the present stage will not occur. If no such limit has been reached at step 130, the process returns to step 110 for another round of negotiation. However, if such a limit has been reached at stage 130, the process proceeds to step 134 wherein the negotiations are terminated and forensic information is returned to Negotiation Manager 22 to enable it to take appropriate action.

Once a determination is made at step 106 that no stages remain to be negotiated, the process completes and the connection is established at step 138 with the agreed values for all parameters. It is contemplated that the negotiation may require one or more participants to refer to outside quotation services or other service providers to obtain cost quotations and/or to verify availability of resources.

In the event that step 134 is reached and forensic information is returned to the participants, this information can be analyzed in an attempt to determine why the negotiation did not converge. After analysis, one or more of the participants (usually at least the agent for the originating End User) can alter one or more parameter values that were agreed at an earlier stage and recommence the negotiation at that stage. For example, if the negotiation was halted at the third stage of negotiation, changes to the values of one or more parameters in the second, or even the first, stage can be made and the negotiations restarted at the earliest stage modified.

The process illustrated in Figure 7 employs a Round Robin negotiating strategy wherein each participant has a chance to review, in turn, the parameter values in a stage before they are agreed to. As will be apparent to those of skill in the art, and as mentioned above, other negotiating disciplines can be employed with the present invention.

While not shown in the process of Figure 7, in some circumstances two or more participants can be in competition in a negotiation. For example, two Service Providers can be interested in provided a link for a communication. In such a case, each Service Provider participates in a negotiation until a discrepancy between there desired values for one or more parameter is experienced and after which Negotiation Manager 22 selects the Service Provider with the more favorable value to continue the negotiations and removes the other Service Provider(s) from subsequent stages of the negotiation, which can simplify those subsequent stages. Of course, other strategies can be employed for selecting between competing participants, including allowing an End User to specify his or her preferences (which could take incentives such as volume discounts or rebates in account), etc. It is contemplated that, as convergence and openness continues to develop in the telecommunications marketplace, the ability to negotiate with competing participants will provide a significant advantage over prior art systems.

Figure 8 shows a flowchart of the method of re-commencing a negotiation. In this Figure, steps which are the same as those of Figure 7 are indicated with the same step numbers. As shown, the process recommences at step 142 where the proposal, with one or more previously agreed parameter values modified, is transferred to Negotiation Manager 22. At step 146, the negotiation commences for the parameter values in the earliest stage with a modified parameter value. The process proceeds next through steps 110, 114, 118, 122, 126, 106, 138 and/or 130 as before. In the event that step 150 is reached and the negotiation is terminated without agreement, the proposal and forensic information is returned to Negotiation Manager 22. Negotiation Manager 22 can be configured to limit repetition of the modification and restart process of Figure 8 a fixed maximum number of times or with any other suitable strategy to ensure that the process stops, even when a

negotiated agreement cannot be reached.

As described above, negotiation in the context of the invention refers to a process in which each participant is able to consider a proposal and either accept or revise the proposal. This is in contrast to the methods in the prior art, particularly, the offer - acceptance model, such as US patent 5,859,979 where the originating entity sends a list of options and a responding entity selects one.

It is contemplated that existing telephony and data communication service providers can modify their routing equipment to apply the invention in a broad range of manners, including adding the new operability as stand-alone equipment, or modifying their existing equipment accordingly and such developments are within the scope of the present invention.

The above-described embodiments of the invention are intended to be examples of the present invention and alterations and modifications may be effected thereto, by those of skill in the art, without departing from the scope of the invention which is defined solely by the claims appended hereto.

WHAT IS CLAIMED IS:

1. A method of establishing communication between at least two entities, where the characteristics of said communication are defined by a set of parameters, said method comprising the steps of:

(i) arranging said set of parameters into a hierarchy of at least two stages with ones of said parameters in one of said at least two stages;

(ii) negotiating, for each stage in turn, values for said parameters in said stage with each of said at least two entities to produce a set of agreed parameter values for each said stage; and

(iii) responding to agreement at all stages by establishing said communication between said at least two entities according to said agreed values for said parameters.

2. The method as claimed in claim 1 wherein, in the case of failure to agree to values for said parameters in a stage at step (ii), said negotiations terminate.

3. The method as claimed in claim 2 wherein failure to agree is determined by a preset time limit being exceeded without agreement being reached.

4. The method as claimed in claim 2 wherein failure to agree is determined by the detection of occurrence of a cycle in values proposed by said at least two entities for at least one parameter.

5. The method as claimed in claim 2 wherein, a terminated negotiation can be recommenced by at least one entity amending one or more parameter values in a previously agreed stage and recommencing said negotiating in step (ii) with all said at least two entities at said previously agreed stage.

6. The method as claimed in claim 1, where in step (ii) negotiation is performed in a round robin manner between all said at least two entities.

7. The method as claimed in claim 6 wherein, in the case of failure to agree to values for said parameters in a stage at step (ii), said negotiations terminate and wherein failure to agree is determined by a preselected number of rounds having been exceeded without agreement between said at least two entities as to one or more parameter values in a stage.

8. The method as claimed in claim 1 including at least three entities and wherein at least two of said at least three entities are in competition to establish said communication, further comprising the step of in step (ii) eliminating from further negotiations any of said at least two competing entities who will not agree to a parameter value agreed by the other of said at least two competing entities in said negotiation.

9. The method as claimed in claim 1 wherein each said entity is represented by an agent which participates in said negotiation on the behalf of said entity.

10. A telecommunications system comprising:

a First User Interface;

a Second User Interface;

a telecommunications network operable to interconnect said First User Interface with said Second User Interface;

each of said First User Interface, Second User Interface and said telecommunications network having an Agent to represent its respective interests in negotiating a communication between said First User Interface and said Second User Interface and each said Agent being operable to agree on values with each other Agent for a set of parameters arranged in a hierarchy of stages to define a desired communication between said First User Interface and said Second User Interface.

11. A telecommunication method for negotiation between participants to establish a desired communication through a telecommunication network, the communication defined by a set of parameters arranged in a hierarchy of stages, the method comprising the steps of, from the highest stage to the lowest stage in turn:

(i) negotiating and agreeing values with said participants for the parameters of a stage under consideration;

(ii) if values for one or more parameters in said stage under consideration cannot be agreed, terminating said negotiation and notifying said participants accordingly;

(iii) if values for parameters in the stage of step (i) are agreed, performing steps (i), (ii) and (iii) for each succeeding stage in said hierarchy;

(iv) when values for all parameters in all stages have been agreed, said participants establishing said desired communication.

12. The method as claimed in claim 11, wherein if said negotiation is terminated at step (ii), forensic information relating to said failure is provided to each participant and wherein one or more of said participants can modify a value for a parameter in a previously agreed stage and can reinitiate said negotiation at said previously agreed stage with said modified value.

13. The method of claim 11 wherein step (i) employs a Round Robin negotiating discipline wherein each participant can agree in turn to the set of parameter values in a stage, before negotiations in said stage are deemed to have been completed.

14. The method of claim 11 wherein two or more participants compete within a stage and said competing participants with the most favorable terms, as defined by values for said parameters in said stage, are selected for inclusion in subsequent stages and any other competing participants are removed from the negotiation of said subsequent stages.

15. The method of claim 11 wherein at least one of said participants is a user interface.

16. The method of claim 11 wherein said communication is a point to point link.

ABSTRACT

A telecommunication system and method provides for negotiation between participants in a desired communication to establish the communication. The desired communication is defined by a set of parameters arranged in a hierarchy of stages and values for the parameters of each higher stage are negotiated before negotiation of those in the next lower stage. When values for all parameters in all stages have been agreed, the communication is established. If one or more parameter values cannot be agreed at a stage, forensic information is provided to the participants who can retry or abandon the negotiations. In one embodiment, a failed negotiation is restarted by a participant modifying a value for a parameter in a previously agreed stage and restarting the negotiation at that stage with the new value. Various negotiating disciplines can be employed to negotiate the stages, including a Round Robin negotiating discipline. Further, two or more participants can compete within a stage and the participant with the most favorable terms is selected for inclusion in subsequent stages while the others are removed from the negotiation.

COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
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COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled Strategy for Negotiation of Telecommunication Resources,

[X] the specification of which is attached hereto

[ ] was filed on _____ as United States Application No. or PCT International Application No. ____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR ' 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. ' 119(a)-(d) or ' 365(b), of any foreign application(s) for patent or inventor's certificate, or ' 365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	(Yes/No) Priority Claimed
Canada	2,300,453	March 10, 2000	Yes

I hereby claim the benefit under 35 U.S.C. ' 120 of any United States application(s), or ' 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. ' 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. ' 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

Application No.	Filed (Day/Mo./Yr.)	Status (Patented, Pending, Abandoned)

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

FITZPATRICK, CELLA, HARPER & SCINTO
Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor Bruno P. Preiss

Inventor's signature _____

Date 2000-3-14 Citizen/Subject of Canada

Residence 53 Thornbush Crescent, Waterloo, Ontario, Canada N2T 1A9

WORLD-WIDE

ASSIGNMENT

WHEREAS, **Bruno P. Preiss**
(hereinafter referred to as the "Assignor"), whose full post office address is:
53 Thornbush Crescent, Waterloo, Ontario, Canada, N2T 1A9
made an invention entitled: **Strategy for Negotiation of Telecommunication Resources**
(hereinafter referred to as the "Invention") for which a Canadian Patent Application was filed on March 10, 2000.

AND WHEREAS, **Soma Networks, Inc.** (hereinafter referred to as the "Assignee"), whose full post office address is 329 Bryant Street, Suite 3C, San Francisco, CA USA, 94107 is desirous of acquiring from the Assignor his entire right, title and interest in and to the Invention.

NOW THEREFORE, to all whom it may concern be it known that for and in consideration of the sum of one dollar ($1.00) to him in hand paid by the Assignee, and other good and valuable consideration the receipt and sufficiency of which is hereby acknowledged, the Assignor does hereby sell, assign and transfer to the Assignee, its successors and assigns, his entire right, title and interest in and to the Invention for all countries and in and to the Canadian Patent Application and any continuations and divisions thereof, and all Letters Patent and any Reissues that may be obtained therefore in Canada, and in and to any corresponding patents and patent applications therefore in all other countries.

AND the Assignor hereby authorizes and requests the Commissioner of Patents to issue Canadian Letters Patent for the Invention to the Assignee, the assignee of the entire right, title and interest in and to the same, for its sole use and benefit; and for the use and benefit of its successors and assigns, to the full end of the term for which Canadian Letters Patent may be granted, as fully and entirely as the same would have been held by them had this assignment and sale not been made.

AND the Assignor hereby undertakes without liability at any time upon request to do everything legally possible to assist the Assignee in the filing and prosecution of any patent application relating to the Invention in any country, to sign such documents and do such things as

may be required to give effective legal and registered title of the Assignee to the Invention in any country, all without further consideration but at the expense of the Assignee.

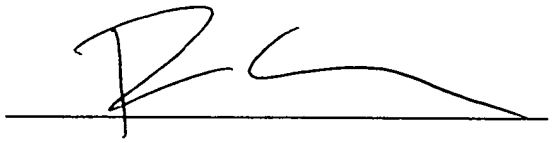
EXECUTED at **Toronto** this 14th day of March, 2000.

Bruno P. Preiss

STATEMENT OF WITNESS

I, **Robert P. Stratton**, whose full post office address is 112 Woodview Drive, Pickering, Ontario, L1V 1L3, hereby declare that I was personally present and did see **Bruno P. Preiss**, who is personally known to me to be the person in the assignment herein, duly sign and execute the same.

Signed at **Toronto** this 14th day of March, 2000.



Establishing and Managing Communications Over Telecommunication Networks

The present invention relates generally to telecommunications, and more specifically, to a method and system of establishing and managing telecommunications over telecommunication networks by providing and enforcing a warranty for communications failing to meet parameters agreed to by the entities involved in the communication.

Background of the Invention

For many decades, telecommunication networks were designed to carry human voices and some data signals, such as Morse Code, in audio bands. However, in the last few decades, telecommunications have been moving into higher bandwidths, using digital signals in order to increase the capacity of physical infrastructures and reducing the cost of supplying telecommunication services. While a copper wire pair in a traditional telephone system carried a single analog voice signal, dozens of voice signals can now be digitized, multiplexed, and transmitted at higher frequencies over the same copper wire pair.

Telecommunication Service Providers now use various transmission means including analog, digital and compressed digital methods, over a variety of media, including hard wire, wireless, fiber optic and satellite transmission means. Data transmission methods and protocols now include Internet Protocol (IP), asynchronous transfer mode (ATM), frame relay, and digital telephony. The networks of these Service Providers are generally interconnected with those of others to form larger, heterogeneous networks.

Currently, two networks dominate telecommunications: conventional telephone networks (public switched telephone networks or PSTNs) with their almost universal physical infrastructure; and the Internet, which has grown tremendously over the last decade and continues to grow.

Telecommunication systems, such as those for telephony and the Internet, are composed of terminal equipment such as telephones or personal computers; an access network such as a telephony local loop or a radio link, switches or routers; and a backbone network such as the PSTN or an intercity data network. One design challenge is that the needs of users at the terminals are very varied, but the backbone networks must handle highly standardized loads in order to operate reliably and efficiently.

Figure 1 is an example of a prior art telephony system 10. System 10 includes a plurality of

switches 12 controlled by large computer programs in switch controllers 14. Switches 12 are interconnected with one another by trunks 16 which carry the actual communication signals and can consist of a variety of physical media, such as optical fiber and coaxial cables. Switch controllers 14 are also interconnected, generally by means of signaling lines 18 rather than over communication trunks 16.

Telephony systems 10 also generally include computing means to implement such features as conference calling 20, voice mail 22 and toll services 24. Telephony features, such as call forwarding, may be implemented by adding code to the programs running the switches 12 or by adding specialized hardware to the telephony system 10. The features available to particular users are defined in databases accessed by software on switch 12, and adding a new type of feature may involve changing these databases together with the software on each switch 12 that uses them, and may also involve purchasing and installing new types of hardware in the system.

Figure 2 is an example of a prior art Internet communications system 30. The Internet 32 itself is represented by a number of routers 34 interconnected by an Internet backbone 36 network designed for high-speed transport of large amounts of data. User's computers 38 may access the Internet in a number of manners including modulating and demodulating data over a telephone line using audio frequencies. Such dial up access requires a modem 40 and connection to the Public Switched Telephone Network 42, which in turn connects to the Internet 32 via a point of presence 44 including a complementary modem 40 and an access controller 46. Another manner of access is the use of broadband modems 50 which modulate and demodulate data onto high frequencies which pass over CATV networks 52, or the like, which are connected to the Internet via a controller 54.

Part of the access network in these systems is usually a set of computer systems 39 at the edge of the backbone network 36 which perform functions such as authentication of users and control of the load that they place on the backbone network 36. Communications between users' computers 38 and the rest of the network 30 are standardized by means of defined communication protocols.

Communications over the Internet can be accomplished via various protocols and over a variety of physical transfer media. A protocol is a set of conventions or rules that govern transfer of data between hardware devices. The simplest protocols define only a hardware configuration

while more complex protocols define timing, data formats, packet construction and interpretation, error detection and correction techniques and software structures.

The Internet is a connectionless network service, in that a single communication may be broken up into a multitude of data packets that follow different paths between the same source and destination. Traditional telephony, in contrast, reserves resources to establish a single dedicated path for a communication that all of the data in the communication follows.

The Internet employs the Internet Protocol (IP) and the key advantages of IP are that it allows a large network to function robustly and that it offers a standardized means by which applications software can use that network. While it offers a number of advantages, actual performance is based on performance levels which are not consistent or absolutely guaranteed and which can, at best, only be statistically estimated.

Networks for telephony and data transmission have developed separately, but the economic rationale for having distinct physical networks is disappearing and the technologies are converging. They appear to be converging on a model closer to that for data than that for telephony, partly because of the greater generality of data networks. The dominant data network is currently the Internet but there is a fundamental difference between these two networks. Conventional telephone systems generally take a "first-come-first-served" approach when there is contention for network resources, denying services to subsequent callers if sufficient resources are not available and this process is known as "call admission". The Internet however, is packet based and has traditionally offered "best effort" service without making any attempt to prioritize traffic. That is, the Internet will accept all traffic, and the flow-through rate will vary with the demands the parties place on the resources available. This difference in operating philosophy makes it difficult to offer traditional services over a converging network.

As well, because the requirements for voice and data transmission can be quite different, it is difficult to optimize for provision of both on a common network. Voice communication, for example, produces a relatively steady stream of data at a relatively low data rate, and rapid delivery is more important than accuracy (i.e. a low end to end latency is more important than a small percentage of dropped packets). In contrast, data applications such as Web browsing or ftp file transfers generally produce bursts of data that are required to be delivered accurately, but for which an end to end latency of a second or two or more may be considered acceptable.

This problem is aggravated by the demand for new services such as video telephony, Internet games, video on demand, Internet audio, streaming audio or video, remote collaborative work or telemedicine, which require differing levels of quality and degrees of bandwidth. Clearly, the network must be able to allocate and control the quality and quantity of bandwidth in order to use its resources efficiently and to meet the needs of its users.

For example, telemedicine surgery in which a physician uses a remote manipulator to perform surgery could likely not be implemented with the existing Internet. This application would require very strict demands on both accuracy and timeliness together with a high bandwidth for video. The consequences of the network failing to perform as required would be very serious.

A contrasting example is multiplayer gaming, in which a number of players exchange small packets of information to update each other on their moves and present state. Given how such games are typically implemented, this can require low latencies, but bandwidth requirements are light and a fairly high rate of packet loss can be tolerated.

Existing networks are not designed to provide such diverse services and performance requirements.

While the Internet provides an efficient network for transporting data packets, it is not designed to provide end to end services with guaranteed performance levels. Typically, there is a static selection of services available to users, under predetermined terms and conditions. The performance level that a user may expect is offered on a "best effort" basis and is not firmly guaranteed.

The Internet has attempted to provide guaranteed quality of service (QoS) by use of the resource reservation protocol (RSVP). RSVP is an extension to IP that permits specification of quality of service at a technical level, in terms of parameters such as data rates and latencies by reserving network resources to establish a 'virtual connection' with the required QoS. It has had limited acceptance due to the complexity it adds to backbone networks and the need for their switching hardware to be updated, and it fails to include mechanisms to specify the costs associated with the QoS demands that it makes. More significantly, RSVP ensures quality of service by reserving resources, a strategy which lacks the efficiencies of the best-effort networks as it can result in the reserved resources being idle at various times.

Asynchronous Transfer Mode (ATM) networks use standard protocols for addressing

packets of data (as does IP), setting up connections (as does TCP), and specifying QoS (as does RSVP). ATM networks have typically been deployed in the core of backbone networks because of the high speeds at which ATM equipment operates, but ATM capabilities have not been directly visible to end users (because of the dominance of IP as an applications standard and the high costs of ATM equipment). Because ATM routers are not directly accessible and because of the complexity of their mechanisms for describing QoS, these mechanisms have not been used by applications software. Further, reservation systems such as ATM or RSVP only deal with network capacity and can still fail to meet performance requirements due to equipment failures, etc. Also, as was the case with RSVP, these QoS mechanisms do not include methods by which to describe the costs associated with a QoS demand.

Therefore, there is currently no efficient way to offer or guarantee QoS over the Internet, other packet networks, or other best-effort networks and, even with call admission networks, there is no effective manner for dealing with missed performance levels. In general, all telecommunication links are error prone, to some level. Service providers can profit by allowing increased error rates and/or latencies and will be tempted to do so. However, users generally have no mechanism to determine when such degradations occur and no mechanism allowing them to be compensated even if they determine such degradations are occurring.

Scott Jordan and Hong Jiang survey a number of models, in which the network offers a rate schedule from which the calling party selects their preference, in "Connection Establishment in High-Speed Networks", IEEE Journal on Selected Areas in Communications, vol. 13, no. 7, September 1995. Nagao Ogino presents a similar methodology, in which a number of service providers bid on the provision of communication services, in "Connection Establishment Protocol Based on Mutual Selection by Users and Network Providers", ACM, 1998. In both cases though, there is no discussion or consideration of how users can ensure they will obtain the performance that they paid for or how they might be compensated if they do not obtain the performance agreed with the service provider.

Users of the existing PSTN are used to very predictable quality and reliability referred to as "four 9's" reliability. That is, successful performance of a voice quality communication can be expected in 9,999 out of 10,000 calls, once a connection is obtained. To date, such reliability cannot be obtained on packet or other networks, but the much lower cost of Internet Protocol based

services and increased diversity will force the PSTN to incorporate those protocols in order to compete. Clearly, some means of addressing this problem is required.

The connectionless telecommunication networks known in the art do not offer guaranteed service levels. Further, there does not exist any mechanism for warrantying communication parameters to users over connectionless, call admission or other telecommunication networks. There is therefore a need for a method and system of providing telecommunication services over connectionless and other telecommunication networks, which improves upon the problems known in the art. This design must be provided with consideration for ease of implementation and recognize the pervasiveness of existing telecommunication infrastructures.

Summary of the Invention

It is therefore an object of the present invention to provide a method and system for establishing and managing communications over telecommunication networks which obviates or mitigates at least one of the disadvantages of the prior art.

According to a first aspect of the present invention, there is provided a method of communication between at least first and second entities over a telecommunication network, where said communication is defined by a set of parameters, said method comprising the steps of:

(i) negotiating between said at least first and second entities an agreed set of values for said parameters that define the desired communication;

(ii) negotiating a warranty agreement between said at least first and second entities defining at least one of said agreed parameters to be monitored and a compensation method to be applied should said at least one monitored parameter fail to meet the corresponding one of said agreed values;

(iii) establishing said communication;

(iv) monitoring said at least one parameter of said communication; and

(v) in the event of a failure of said monitored parameter to meet said agreed value, compensating at least one of said first and second entities in accordance with said negotiated compensation method.

According to another aspect of the present invention, there is provided a telecommunications system comprising:

a first end user;

a second end user;

a telecommunications network interconnecting said first end user said second end user and having at least one transmission link and protocol;

said first end user and said telecommunication network negotiating a communication between said first end user and said second end user; and

said first end user and said telecommunication network being operable to:

(a) agree on values for a set of parameters defining a communication between said first end user and said second end user; and

(b) agree on a warranty agreement defining at least one of said set of parameters to be monitored and a compensation method to be applied should said at least one monitored parameter fail to meet the corresponding one of said agreed values.

In the present invention, communications between at least two end users are achieved over at least one telecommunications link. Preferably, the communication is defined by a set of parameters, usually including one or more network performance parameters and/or QoS parameters, which are negotiated by, or on behalf of, at least one of the end users with the one or more network service providers who will establish the communication. A successful negotiation results in an agreed set of values for the parameters and a warranty agreement with the network service provider that defines at least one of the agreed parameter values to be warranted. The warranty agreement also defines a compensation method to be applied should a measured value of the parameter fail to meet the corresponding agreed value.

Once the communication is established, the agreed warranted parameter, or parameters, are monitored and, in the event of a failure of a monitored parameter to meet the agreed values, the compensation method is invoked and at least one user or other entity involved in the communication is compensated in accordance with the compensation method. If multiple users are involved in a communication, the compensation can be divided amongst them according to an agreed scheme. Similarly, if multiple network service providers are involved in the communication with the users and/or in establishing point to point links in the communication, the network service provider who fails to meet agreed parameters can compensate other network service providers and/or users, as appropriate. Compensation can be achieved in a variety of

manners, including by monetary means, including reduced billings, refunds and/or penalty payments, or by the provision of free or reduced rate communications, either for the present communication or for a future communication.

The telecommunication network can be a call admission network, a connectionless network, a virtual connection network or any combination of these networks. In the case of call admission networks, the negotiation of values for communication parameters can be trivial, but a warranty can still be agreed and provided.

Brief Description of the Drawings

Embodiments of the present invention will now be described, by way of example only, with reference to the attached Figures, wherein:

Figure 1 shows a block diagram of a prior art public switched telephone network (PSTN);

Figure 2 shows a block diagram of a prior art Internet network;

Figure 3 is a generalized flow chart of the method employed in a warranty mechanism in accordance with the present invention; and

Figure 4 is a flow chart of a warranty mechanism for communications in an embodiment of the invention.

Description of the Invention

Figure 3 shows a high level view of the implementation of a methodology in accordance with the present invention. This Figure presents a method of communication between a first entity (a first end user) and a second entity (a second end user) over a telecommunication network, operated by a single network entity, to which the end users are connected and where the communication is defined by a set of agreed values for communication parameters agreed by the entities. In this example, the second end user is passive, as the communication recipient, and the first entity and the network entity agree on the set of values for the parameters at step 56. The entities also agree which, if any, of those values are warranted. As described below, the parameters are any suitable set of parameters and, for example, can include a minimum data rate, a maximum latency, a maximum frame error rate, etc. If one of the agreed values for those parameters is not met during the execution of the communication at step 58, and if that parameter

or parameters are warranted, then the system responds by triggering a warranty mechanism at step 60.

The phrase "entity" is used herein to describe hardware or software that represents any party having an interest in the parameters for the communication. Such parties can include end users, their service providers, interconnecting (point to point link) service providers, etc. End users, for example, will have terminal devices which allow the end user to communicate audio, video, data or other similar information with other users, and such terminal devices can include telephones, personal computers, personal digital assistants, cellular telephones, pagers, fax machines or other devices as known in the art. Such user terminal devices are referred to herein as user interfaces. Service providers can, for example, communicate with the end users via dial-up, cable or wireless modems, or using technologies such as ISDN (integrated services digital network), xDSL (digital subscriber line), ATM (asynchronous transfer mode) and frame relay and can communicate with each other through any suitable interconnection between their networks.

The present invention is not limited to use with communications involving only two end users and a network entity and communications can be established wherein multiple service providers are engaged to provide necessary links. Also, multi-user services such as conference calls and streaming video will necessarily involve multiple entities even in circumstances wherein a single service provider is involved. While in the example of Figure 3 only a first entity (first user) and a second entity (network service provider) are involved in negotiations it is also contemplated that multiple entities can be involved in negotiations including the second and/or additional end users and each service provider.

The parameters that define the communication will depend on the nature of the communication that is desired. In the simple case of a voice call, the parameters can include: the price and its basis (i.e. – how much per packet or per minute, etc.), an identification of who pays, and performance and/or QoS parameters such as the maximum latency that will be tolerated and the required voice sampling quality.

As explained above, there are currently two main telecommunications networks, the public switched telephone network (PSTN) and the Internet, but economics and competition are forcing these to converge into a single data network. The protocols which use the network resources most efficiently are "best-effort", or connectionless, protocols which accept all traffic, and vary the

flow-through rate with the demands placed on the resources available. Because there is an inherent failure rate and variable performance for such networks, the expected performance is not consistent nor can it be absolutely guaranteed, though performance can be statistically estimated.

By providing a warranty for the agreed terms of the communication, the agreement between entities receives credibility and efforts to achieve the agreed terms are in the best interest of all entities. Entities can control the degree of confidence they can expect in the agreement by controlling the terms of the warranty. Negotiating a communication with strict warranty terms and/or onerous penalties will typically afford the communication a higher priority on a service provider's network.

As explained above, there is a growing demand for diverse services, which require telecommunication service providers to allow service parameters to be tailored to the specific requirements of the users. As the prevailing networks are "best-effort", there is no guarantee a communication will perform as agreed. Some way is therefore required to enforce the terms of the agreement, which the present invention accomplishes by providing and enforcing a warranty mechanism.

In the past, when an end user agreed to a communication, he could receive lower quality than he agreed to pay for because of failures and statistical variability. The present invention controls the tradeoff of cost to quality by controlling what is paid for the quality that is actually received. This is accomplished by compensating the appropriate entities when the agreed performance is not met, through the warranty mechanism.

The present invention also allows new services, or types of Quality of Service, to be provided via a communication network. For example, a network service supplier can sell a quality of service to its end users which warrantees that they will not receive annoying calls, such as telemarketing, etc. In such a case, the network service supplier can enforce a warranty parameter whereby any of its end users can activate an "annoying call" identifier when they receive a communication that they did not wish to receive and the originator of such a call will be forced to pay a penalty to the offended end user. A user receiving a telemarketing call can effect the warranty mechanism by any suitable means, such as pressing a Flash and a dial pad number during or after the call. In effect, the call originators are warrantying that their calls will not offend end users. Similarly, a telemarketer or other caller can pay a network service supplier to contact a user

on a person to person basis and the warranty mechanism can be invoked when an answering machine is reached instead. The warranty mechanism can, in this case, refund a portion of the price paid for the connection as it was not person to person. Other new and unique services can be provided in a similar manner, as will be more readily apparent after reading the rest of the disclosure below.

Figure 4 shows a more detailed flow chart of a method in accordance with the present invention. The process begins at step 62 where the negotiating entities agree on a set of values for the parameters defining the communication they wish to establish. The negotiation can be a simple matter of a communication service provider having a standard set of offerings, from which the calling party makes a selection or can be a multi-entity, multi-round negotiation wherein service providers, service levels, pricing and warranty terms must be agreed. In either case, the negotiation is administered by a negotiation manager or other suitable mechanism agreed to by the entities.

The negotiation manager can be any suitable mechanism which allows the entities to identify and agree to a set of parameters and values. In a presently preferred embodiment, the negotiation manager is a software application executing on at least one computing device connected to the participating entities, directly or indirectly. Ideally, the negotiation manager is operated and maintained by a trusted party which ensures that fair negotiations occur.

The negotiated parameters can include: minimum sustained data rates, maximum burst rates and durations, duty cycles, maximum acceptable frame error rates, maximum acceptable end to end latencies, etc. This negotiation would also include the terms of the warranty agreement, including an identification of which parameters are to be warranted and a definition of the consequences of a failure to meet the warranted performance.

Warranted parameters can be agreed in a variety of flexible manners, including conditional, graduated or absolute parameters. A conditional parameter is a parameter which is dependent upon the value of another parameter, such as a frame error rate that can depend on, and/or vary with, a warranted data rate with the permitted number of errors increasing as the data rate increases and vice versa. A graduated parameter is a parameter with different behaviors at different levels. For example, a data rate which is warranted to provide continuous transfer rates of five hundred kilobits per second (kps) can have an agreed monetary warranty mechanism of a tenth of a cent refund for each packet transmitted at less than the agreed five hundred kps rate and more than a

three hundred and fifty kps rate and a full cent refund for each packet transmitted at a rate less than three hundred and fifty kps. An absolute parameter is a parameter whose condition is either met or not, for example end to end latency can be warranted to not exceed one hundred milliseconds and if this limit is exceeded, then the warranty mechanism is invoked.

In order to negotiate such an agreement, a communication provider can assess their risk in agreeing to the terms of the warranty. The simplest business model is:

Profit = negotiated rate - cost of service - cost of warranty

That is, for a given service with a fixed cost and fixed profit target, there is a tradeoff of the negotiated rate against the cost of the warranty. Therefore, a simple view of the rate to charge is:

Charge out rate $\geq$ desired profit + cost of service + (P x warranty cost)

where P is the probability (between zero and one) that the proposed value for the specified parameter or parameters will not be met. Because errors and failures can be modeled and estimated statistically, a "bet" or tradeoff between the warranty cost and charge out rate can be created. Probability P can be calculated based on historic data, for the case of failures, and expected loading of the resources and can be influenced by the amount of risk the service provider is willing to accept versus the amount of redundant (unused) capacity he has in his network, etc. As the communication service provider has some degree of control over the loading, the expected results can be very predictable. The communication service provider does not have control over bursts and the like, but can negotiate the parameters associated with bursty data to limit their exposure to an acceptable level for the charge out rate. More complex formulas for determining the Charge Out Rate can be employed, for example taking other factors such as total amounts paid by a user, the desirability of providing services to the user, the present state of the provider's network, the time of day, etc., into consideration

It is also important to note that different telecommunication models or paradigms will have different cost curves and break even points. More complex methods can be employed, including starting with calculated statistics which are modified as additional network usage data is collected. The calculation of such curves is well within the ability of those skilled in the art.

At step 64, once the terms of the agreement have been negotiated, the negotiation manager advises a trusted party of the terms of the agreement, which parameters to monitor, and how to effect the warranty. In a simple application, where the calling party pays for a communication, the

"trusted party" can simply be a software function that the network service provider has created and which the calling party intrinsically trusts. In more complex applications, an independent software agent, or other suitable mechanism, can be used with, for example, each participant confirming their trust through a suitable method, such as by submitting a non-revocable password.

At step 66, the trusted party establishes a mechanism to monitor the agreed parameter or parameters to which the warranty applies while the communication proceeds. As noted above, the most likely parameters to monitor are performance parameters such as latency and bit or frame error rates, although other parameters, including end user satisfaction parameters (such as the "annoying call" parameter discussed briefly above) can also be monitored.

Latency is the amount of time a data packet requires to travel from a transmitting entity to a receiving entity. In the case of communications through multiple links, the measure most often of interest is the end to end latency, which is the total time a packet requires to travel from the originating entity to the final destination entity, i.e. – the sum of the latency on all links in the communication. In voice communications, the maximum end to end latency that is generally found acceptable is about 200 milliseconds, though in the case of the present invention, different acceptable maximum latencies for voice communication can, of course, be negotiated. For data communications, a much wider range of latencies may be of interest, depending upon the nature and use of the data. Latency can be monitored, or estimated, in a number of ways such as time stamping of packets, etc. as will be apparent to those of skill in the art.

Another parameter for which warranties likely will often be desired is the bit error rate (BER) or, more commonly, the frame error rate (FER). Again, suitable methods of detecting BERs or FERs are well known to those of skill in the art and acceptable ranges of BERs and/or FERs will again differ depending upon the nature and use of the data.

The mechanism to monitor agreed parameters will depend upon which parameters are to be monitored, but establishment of such suitable mechanisms is within the normal skill of those skilled in the art.

At step 68, for the duration of the communication or warranty period (whichever is less), the trusted party monitors whether the performance of the communication meets the terms of the warranty agreement. If no exceptions to the warranty terms (failures) are encountered during the warranty period (which can be a time, a number of packets, the duration of the communication, etc.

- as specified in the negotiated terms), the process continues until expiry of the warranty period. If the warranty is not fulfilled (i.e. – a failure has occurred), control passes to steps 70, 72 and 74.

At step 70, the trusted party advises the entities as to what performance parameter, or parameters, was not satisfied and what the ramifications of that failure are. At step 72, the trusted party can allows participants the opportunity to release the communication to renegotiate its terms, though the participant responsible for the failure is still bound to honor the agreed warranty. This allows the entities to cancel a communication which is completely unacceptable and to create a new communication. It is contemplated that a penalty clause can be negotiated as part of the warranty agreement negotiations whereby the participants agree to a penalty that is incurred should a participant wish to renegotiate the communication after a failure.

If a renegotiation has occurred, the process can recommence at step 64, after payment of any such penalty and/or enforcement of the warranty mechanism of step 74.

Finally, at step 74, the trusted party enforces the agreed warranty, most often by compensating, in an agreed manner, the entity paying for the communication. If a penalty clause has been negotiated, this too is enforced. As described above, multiple entities can have an interest in the communication and can be using shared billing, so it can be appropriate and/or necessary to compensate multiple participants.

As will be apparent to those of skill in the art, specific steps 70, 72 and 74 are not essential and are merely preferred aspects of an embodiment of the invention. All that is required for the present invention is that, upon detection of a failure under the warranty terms, steps that are agreeable to the participants are performed to compensate, in some form, for the failure to meet the agreed communication parameters. Thus, for example, step 72 may be omitted altogether if the entities have agree that the communication cannot be renegotiated. Alternative and/or additional steps to steps 70, 72 and 74 can also be performed within the scope of the invention as will be apparent to those of skill in the art.

Compensation can apply to the current communication (an immediate reduction in the cost for the communication, etc.), or to future communications (a credit to be applied to an entity's account) effected by the entities. The form of compensation is not particularly limited, but could include: a financial warranty, such as reduced rate for the communication or reduced billable duration for the communication. For example, the calling party may negotiate a required voice

quality of greater than MOS (mean opinion score) 3.5 for which the compensation for a failure would be a refund of charges for the last five minutes of the communication; or a product warranty, such as allowing the calling party to extend the call at no additional cost, giving free time, or a free quantity of data or frames on an agreed basis, such as ten free frames for every dropped frame.

The present invention can be employed to warrant an end to end communication (i.e. – between two end users) or to warrant one or more point to point links in an end to end communication, as desired.

While it is currently preferred that the present invention be employed with a network wherein parameters for communications are negotiated, it is also contemplated that the present invention can be employed to allow existing PSTN service providers the option of using connectionless networks for their PSTN calls. In such a circumstance, the PSTN service provider can offer its clients a predetermined warranty agreement for the communications which it establishes over these networks. As described above, when performance is not met, the user receives a predefined compensation under the warranty. This would allow existing PSTN service providers to improve their efficiency by using other networks, without requiring reservation of resources or extensive over-provisioning of network capacity. Also, a selection of such a warranted service or conventional service can be offered to the end user when they establish their connection. This would allow, for example, business calls to be completed via the conventional PSTN network and personal calls to be completed via the warranted network. Such a selection can be effected by a dialing prefix, interactive voice response (IVR) or by any other suitable mechanism as will occur to those of skill in the art.

Further, depending upon the warranty terms and the cost that can be charged for a communication, a service provider can select between establishing a communication based on a connectionless network or other networks, such as those employing call-admission systems, RSVP protocols, etc. In this manner a service provider can provide a range of alternative communication structures as makes economic sense for a particular communication.

It is also contemplated that a communication can be established with one or more links provided on call-admission, or PSTN network, and a connectionless link. In such a case, warranties are implemented on the appropriate links (i.e. – the non call admission or PSTN links).

As described above, the present invention provides a novel telecommunication system and method for communicating between at least two end users, as represented by user interfaces, over at least one link which is provided by a telecommunication network. Preferably, the communication is defined by a set of parameters, usually including one or more network performance and/or QoS parameters, which are negotiated by, or on behalf of, at least one of the users with the one or more network service providers who will establish the communication. A successful negotiation includes defining a set of values for the parameters and a warranty agreement with the network service provider or providers defining at least one of the agreed values for the parameter to be warranted and a compensation method to be applied should a measured value of the parameter fail to meet the corresponding agreed value.

Once the communication is established, the agreed warranted parameter, or parameters, is monitored and, in the event of a failure of the monitored parameter to meet the agreed values, the compensation method is invoked and at least one user or other entity is compensated in accordance with the compensation method. If multiple users are involved in a communication, the compensation can be divided amongst them according to an agreed scheme. Similarly, if multiple network service providers are involved in the communication with the users and/or establishing point to point links in the communication, the network service provider who fails to meet agreed parameters can compensate other network service providers and/or users, as appropriate. Compensation can be by monetary means, including reduced billings, refunds and/or penalty payments, or by the provision of free or reduced rate communications, either for the present communication or for a future communication.

As is also mentioned above, parameters to be warranted can be quite broad and can include service (or content) parameters to warrant such things as no telemarketing calls, etc. In the case of telemarketing, or similarly annoying calls, the warranty mechanism cannot warrant that such calls will not occur, but can compensate the end user for the annoyance when they are experienced. With such a communication, a telemarketer is accepting the risk that the cost of the warranty compensation will be avoided by end users not activating the warranty mechanism (which could be a simple Flash and press of a dial pad button, i.e. – flash and 0) or is acceptable, given a level of success in the marketing effort over several end users.

The above-described embodiments of the invention are intended to be examples of the

present invention and alterations and modifications may be effected thereto, by those of skill in the art, without departing from the scope of the invention which is defined solely by the claims appended hereto.

WHAT IS CLAIMED IS:

1. A method of communication between at least first and second entities over a telecommunication network, where said communication is defined by a set of parameters, said method comprising the steps of:

(i) negotiating between said at least first and second entities an agreed set of values for said parameters that define the desired communication;

(ii) negotiating a warranty agreement between said at least first and second entities defining at least one of said agreed parameters to be monitored and a compensation method to be applied should said at least one monitored parameter fail to meet the corresponding one of said agreed values;

(iii) establishing said communication;

(iv) monitoring said at least one parameter of said communication; and

(v) in the event of a failure of said monitored parameter to meet said agreed value, compensating at least one of said first and second entities in accordance with said negotiated compensation method.

2. The method as claimed in claim 1, wherein said warranty agreement further defines a penalty clause allowing an entity responsible for said monitored parameter and failing to meet said agreed value to renegotiate said communication by providing a penalty compensation, defined in said warranty agreement.

3. The method as claimed in claim 1, wherein step (iv) is performed by a third entity trusted by each of said at least first and second entities.

4. The method as claimed in claim 1, wherein said compensation is a monetary compensation.

5. The method as claimed in claim 1, wherein said compensation is by the provision of a reduced cost for said communication.

6. The method as claimed in claim 1, wherein said compensation is by the provision of a reduced cost for a future communication between said at least first and second entities.

7. The method as claimed in claim 1, wherein said compensation is by the provision of an agreed amount of data transfer through said communication at no cost to said compensated entity.

8. The method as claimed in claim 1 wherein at least a third entity is involved in providing said communication between said first and second entities, said third entity providing a point to point link for said communication and having agreed to said negotiated set of values for said parameters and to said warranty agreement and wherein, when compensation is provided in the event of a failure, said compensation is shared between at least two of said entities

9. The method as claimed in claim 1, wherein said at least one parameter of said communication which is monitored is the latency of said communication between at least two entities involved in said communication.

10. The method as claimed in claim 1, wherein said at least one parameter of said communication which is monitored is an error rate experienced during said communication between at least two entities involved in said communication.

11. The method as claimed in claim 1 wherein said at least one parameter that is monitored is the type of communication and one of said at least two entities performs said monitoring.

12. The method as claimed in claim 1 wherein said at least one parameter that is monitored is the identity of the entity receiving the communication.

13. The method as claimed in claim 1 wherein said at least one parameter is conditional on another parameter of said communication.

14. The method as claimed in claim 1 wherein the amount of compensation paid in step (iv) is

graduated and dependent upon the degree to which said at least one monitored parameter is not met.

15. A telecommunications system comprising:

a first end user;

a second end user;

a telecommunications network interconnecting said first end user said second end user and having at least one transmission link and protocol;

said first end user and said telecommunication network negotiating a communication between said first end user and said second end user; and

said first end user and said telecommunication network being operable to:

(a) agree on values for a set of parameters defining a communication between said first end user and said second end user; and

(b) agree on a warranty agreement defining at least one of said set of parameters to be monitored and a compensation method to be applied should said at least one monitored parameter fail to meet the corresponding one of said agreed values.

16. The telecommunications system as claimed in claim 15 wherein the compensation method includes paying a monetary compensation to at least one of said first and second end users.

17. The telecommunications system as claimed in claim 15 wherein a third party, trusted by said first end user and said telecommunication network, monitors said communication to ensure said monitored parameter is met.

ABSTRACT

A telecommunication system and method for communicating between at least two end users over a telecommunication network, where the communication is defined by a set of parameters. At least two entities, such as one or both of the end users and/or the service providers negotiate an agreed set of values for said parameters that define the desired communication. The entities also negotiate a warranty agreement with the network service provider defining at least one of the agreed parameters to be warranted including a compensation method to be applied should said at least one monitored parameter fail to meet the corresponding one of said agreed values. The agreed warranted parameters are monitored once the communication is established and, in the event of a failure of the monitored parameters to meet agreed values, at least one of the entities is compensated in accordance with the agreed compensation method. When more than two entities are involved in a communication, the compensation from an entity can be divided amongst the other entities according to an agreed scheme.